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AUTHOR INDEX

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SUBJECT INDEX

The underlined number followed by a colon is the volume number, and the numbers following are the abstract numbers. The designation (R) following an abstract number indicates that it is an abstract of a progress report; the designation (J) indicates that it is an abstract of a journal (published literature) article; and the designation (P) indicates that it is an abstract of a patent. Abstract numbers for reports other than progress reports carry no letter designations.

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NEW NUCLEAR DATA

1. Radioactivity, Levels, Abundances, Moments
2. Neutron Cross Sections
3. Ground State Q's
4. Mass Differences and Ratios

INTRODUCTION

The nuclear data presented here have been compiled by the Nuclear Data Group which is sponsored by the National Research Council and supported by the Atomic Energy Commission and the National Bureau of Standards.

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This issue of Nuclear Science Abstracts contains the semi-annual cumulated list of new nuclear data. Issue 18B will contain the next quarterly list and issue 24B the annual cumulation of all data in the 1954 lists.

As the current literature is surveyed, the new nuclear results are first printed on 3" × 5" cards which are collected into sets of 100 to 150 cards each month. Individuals, laboratories, or libraries may subscribe to the card sets directly by applying to the Nuclear Data Group, National Research Council, 2101 Constitution Avenue, N. W., Washington 25, D. C. The price, based on actual mechanical costs is currently $20 per year domestic and $30 per year foreign (air mail postage included for foreign but not for domestic subscriptions).

CONVENTIONS

All energies are given in Mev and all cross sections in barns unless otherwise stated in the tabular material.

Numerals in italics following a measured value are the error (as reported by the authors) in the last figures of the values. In cases where confusion seems possible, the conventional ± is used.

Magnetic moments are reported as before without diamagnetic correction but are now based on $\mu(H) = 2.79267$ and the substandards listed by H. Walchli, ORNL-1469.

In writing reactions in Table 1, Radioactivity, Levels, Abundances, Moments, superscripts to denote the A value of the target nucleus have been used only when the target material is monoisotopic or has been isotopically enriched. "B^{10}(d,p)," for example, means that the d,p reaction was observed in a sample enriched in B^{10} while "B(d,p)" means it was observed in natural B. This policy was followed previously for "heavy" but not for "light" nuclei. It was not practical to adhere to it in Table 3, Ground State Q's. In this table enrichment is denoted by underlining the A superscript.

Even when enriched material is not used, the nucleus under which the information is listed is often fairly certain because of some large natural abundance or cross section, or because of the particular activity produced or energy released. In such cases the nucleus in question is put down without following "?." When there is no indication as to the isotope involved, information is listed under the element in question.

When a method of production of a radioactive nucleus has been given, the lowest bombarding energy used by the experimenter is indicated; e.g. Ag(20-Mev p). If this energy has actually been determined to be the threshold, it is underlined, e.g. Sn(<u>14-Mev p</u>).

The large black dots on the decay schemes are used to indicate experimentally established coincidences. α, β, or γ-rays entering a level and dotted at their arrowheads have been shown to be in coincidence with gamma-rays leaving the same level and dotted at their origins. In case of a simple cascade the dots of the incoming and outgoing rays are superimposed.

Electron capture, ϵ, is shown on decay schemes by long and short dashes. Dashes of equal length are used for doubtful radiations or levels.

For the light nuclei, energy levels in the compound nucleus are tabulated rather than the resonant energy of the bombarding particle. The binding energy of the bombarding particle in the compound nucleus is taken from the table of F. Ajzenberg, T. Lauritsen, Rev. Mod. Phys. 24, 321(1952) for Z 10, and from P. M. Endt, J. C. Kluyver, Rev. Mod. Phys. 26, 95(1954) for Z from 11 to 20.

ABBREVIATIONS

a	absorption measurement
$a\beta\gamma$	absorption of β's in coincidence with γ's
ace^-	absorption of conversion electrons
a coin	measurement by placing absorbers between counters in coincidence
α	total γ-ray conversion coefficient, N_e/N_γ
$\alpha_K, \alpha_L, \ldots$	γ-ray conversion coefficient for electrons ejected from the K,L, ... shell
$\alpha_0, \alpha_1, \ldots$	α to g.s., first excited state, ... of residual nucleus
b	coefficient in angular correlation function, $1 + b \cos^2 \theta$
B	band spectra method
Beγn	measurement by detection of photoneutrons from Be
B_n, B_p	Binding energy of a neutron, proton <u>to</u> a nucleus
$\beta\gamma(\theta)$	angular correlation of β's and γ's in coincidence
Calc	calculated from experimental work reported elsewhere
cc	cloud chamber
CcW	Cockcroft Walton accelerator
ce^-	conversion electrons
chem	chemical separation of product following reaction
Cpt	Compton electrons
d	(1) deuteron, (2) descendant of, (3) days, when used as superscript
$d,p(\theta)$	angular distribution of protons with respect to deuteron beam
Dγn, Dγp	measurement by detection of photoneutrons or photoprotons from deuterium
$\overline{E}$	average energy
E_0	resonance energy
$E_\beta, E_\gamma, \ldots$	energy of β ray, energy of γ ray, ...
E_{dis}	disintegration energy
EA	electrostatic analyzer
E1,E2, ...	electric dipole, electric quadrupole, ...
ϵ_A	Auger electron
el	elastic scattering
ϵ	electron capture
ϵ_K, ϵ_L	electron capture from K, L shell
f	fission, in abbreviations for methods of production or detection
F-K	Fermi-Kurie β energy distribution plot
$\gamma(\theta,T)$	numbers of γ's as function of angle and temperature
$\gamma\gamma, \beta\gamma, \alpha\gamma, n\gamma$	$\gamma\gamma, \beta\gamma, \alpha\gamma$, or $n\gamma$ coincidences. (0.123 γ) (0.246 γ, 0.325 γ) means 0.123 γ in coincidence with 0.246 γ and 0.325 γ
Γ	resonance half-width (the whole width at half-maximum)
G-M	Geiger-Müller counter
g.s.	ground state
I	(1) nuclear induction magnetic resonance method; (2) spin in units $h/2\pi$. + or − signs after spin values denote even or odd parity of state in question
ic	ionization chamber
IT	isomeric transition
J	quantum state of compound nucleus in a nuclear reaction. "I" is used to denote the spin of the target nucleus, final nucleus
K/L	α_K/α_L
l	angular momentum of particle absorbed into nucleus
M	molecular or atomic beam resonance method
M1,M2, ...	magnetic dipole, magnetic quadrupole ...
mb	millibarns
Mic	microwave method
mir	measurement by total reflection of neutron beam from mirror surface
ms	mass spectrometer
μ	(1) magnetic moment in units of nuclear magnetons, (2) micron, 10^{-4} cm
μs	microseconds
osc	pile oscillator method
p	(1) proton, (2) predecessor of
p res	proton resonance. Magnetic field standardized by means of proton resonance frequency
para	paramagnetic resonance method
parentheses	parentheses are put around values which are given for identification purposes
pc	proportional counter
pe^-	photoelectrons
ppl	photoplates or emulsions
primes	primes indicate inelastically scattered particles
q	electric quadrupole moment in units of barns
quad res	quadrupole resonance method
Q	reaction energy in Mev
s	(1) spectrometer method, (2) seconds, when used as superscript
s pr	pair spectrometer
S	atomic spectra measurement
scin	scintillation counter
2 cryst scin s	2-crystal scintillation spectrometer
sl	lens spectrometer
sl ce^-	conversion electrons measured in lens spectrometer
st	strong
sπ	180° spectrometer
$s\pi\sqrt{2}$	double focusing spectrometer
σ	cross section in barns
σ_0	cross section at resonance energy, E_0
σ_a	absorption cross section
σ_{el}	elastic scattering cross section
σ_{in}	inelastic scattering cross section
σ_s	scattering cross section
t	(1) triton, H^3, (2) total cross section when used under σ in cross section list
T	(1) isotopic spin; (2) temperature
τ	half life in units indicated
τ_1, τ_2	half life of upper, lower state
$\tau_{\beta\beta}, \tau_{\epsilon\epsilon}$	half life for double β, double ϵ decay
th	thermal
VdG	Van de Graaff accelerator
w,vw	weak, very weak
%	% of disintegrations
†	relative numbers. When used in connection with γ rays, relative numbers of photons, not photons plus conversion electrons, are meant
+,−	even, odd parity when used in connection with level properties

Standard journal abbreviations are used.

1. RADIOACTIVITY, LEVELS, ABUNDANCES, MOMENTS

n^2 0 2 ?

$56^h Ni^{66}$ not found by (n^2,p) when Cu exposed to possible n^2 from Bi(23-Mev p,n^2)

B.L.Cohen, T.H.Handley, Phys. Rev. 92,101, (1953).

H^2 1 1 stable

Capture γ H(n,γ) E_n= th scin
2.23
No other γ (E_γ = 0.02 to 3) (<5%)

B. Hamermesh, R.J.Culp, Phys. Rev. 92,211(1953).

H^3 1 2 12.4y

β^- 0.0176 4
Neutrino mass(kev): <0.500(Dirac) < 0.250 (Majorana), < 0.150 (Fermi)

D.R.Hamilton, W.P.Alford, L.Gross, Phys. Rev. 92, 1521 (1953).

He^4 2 2 stable

σ graph H^2(d,p) E_d = 0.013 to 0.113 pc
σ graph H^2(d,n) E_d = 0.013 to 0.113

W.R.Arnold, J.A.Phillips, G.A.Sawyer, E.J.Stovall, Jr., J.L.Tuck, Phys. Rev. 93, 483 (1954); 88, 159A (1953).

He^5 2 3 $\sim 10^{-21}$s

Levels $H^3(He^3,p)$ E_{He^3} = 0.30
g.s. p group observed at E_p= 9.33 scin
No group to first excited level observed

C.D.Moak, Phys. Rev. 92,383(1953); 91,462A(1953).

Levels Li^6(n,d) E_n = 14 ppl
g.s. l_p= 1 Γ= 0.8 n,d(θ)
(~2.6)* l_p= 1?
*Deuterons with E_d = 1.7 to 3.1 below g.s. group. No deuteron peak ascribable to 2.6 level seen.

Li^7(n,t) E_n = 14 ppl
g.s. n,t(θ)
(~2.6) observed ?

G.M.Frye, Jr., Phys. Rev. 93, 1086 (1954).

Level H^3(d,n) E_d = 0.007 to 0.12
16.64 pc
σ_{max} = 4.95 at E_d = 0.107

W.R.Arnold, J.A.Phillips, G.A.Sawyer, E.J. Stovall, Jr., J.L.Tuck, Phys. Rev. 93, 483 (1954); 88, 159A(1953).

He^7 2 5

Li^7(n,p) E_n = 14
Reaction not observed, $\sigma \leq$ 5mb for $-1 > Q > -7$

G.M.Frye, Jr., Phys. Rev. 93, 1086 (1954).

Li^5 3 2

$He^3(He^3,p)$ E_{He^3} = 0.1 to 0.8
g.s. p group observed at 90° with $E_p \sim$ 8.5
No group to first excited level scin

W.M.Good, W.E.Kunz, C.D.Moak, Phys. Rev. 94, 87 (1954).

Levels He(p,p) E_p = 5.78
p,$\alpha(\theta)$ phase shift analysis shows large splitting of $P_{3/2}$,$P_{1/2}$ levels ($\Delta E_\lambda \sim$ 6-Mev) in agreement with Dodder and Gammel, Phys. Rev. 88, 520 (1952).

W.E.Kreger, W.Jentschke, P.G.Kruger, Phys.Rev. 93, 837 (1954).

Capture γ $He^3(d,\gamma)$ E_d = 0.46
16.6 2 scin
$\sigma_{max} \sim$0.05 mb for E_d = 0.46

N.M.Hintz, J.M.Blair, D.M.Van Patter, Phys. Rev. 93, 910, 924A(1954).

Level $He^3(d,\alpha)$ E_d = 0.38 to 0.56
(16.8) J = 3/2+
σ_{max} = 0.94 for E_d = 0.43

G.Freier, H.Holmgren, Phys. Rev. 93,825(1954).

σ graph He^3(d,p) E_d = 0.036 to 0.093 pc

W.R.Arnold, J.A.Phillips, G.A.Sawyer, E.J.Stovall, Jr., J.L.Tuck, Phys. Rev. 93, 483 (1954); 88, 159A (1953).

Li^6 3 3 stable

|q| >0 Li^6Cl M
$q(Li^6)/q(Li^7)$ is positive

P. Kusch, Phys. Rev. 92, 268 (1953).

$|q(Li^6)/q(Li^7)|$ = 0.019 $LiAl(SiO_3)_2$ quad res

N.G.Cranna, Can. J. Phys. 31,1185 (1953).

Level He(d,d) E_d = 1.0 to 2.0
2.187 J = 3+ Γ = 0.035
σ and d,d(θ)
No level between 2.2 and 3.2

T.Lauritsen, T.Huus, Phys. Rev. 92,1501(1953).

Levels He(d,d) E_d = 0.3 to 4.6
(2.187) parity + $\Gamma \sim$0.035 σ
3.58 level not observed

A.Galonsky, R.Douglas, W.Haeberli, M.McEllistrem, H.T.Richards, Phys. Rev. 93, 928A(1954).

Li^6
3 3
stable

He (d,γ) E_d = 1.05
No 2.19 capture γ (σ < 0.1 mb) scin

R.M.Sinclair, Phys. Rev. 93, 1082 (1954).

Level Be^9 (p,$\alpha\gamma$) E_p = 2.72
γ 3.57 sl Cpt,pe$^-$
M1 from internal e$^+$ spectrum
Doppler correction (26 kev) not subtracted

R.J.Mackin, Jr., Phys. Rev. 94, 648 (1954).

Li^7
3 4
stable

Levels B(n,α) E_n = th
6.52† g.s. lc
93.48† (0.478)
†Relative cross sections

J.A.DeJuren, H.Rosenwasser, Phys. Rev. 93,831 (1954); 92, 544A(1953).

Levels Li^6 (d,p) E_d = 8
g.s. l_n = 1 d,p(θ)
(0.478) l_n = 1

J.R.Holt, T.N.Marsham, Proc. Phys. Soc. 66A,1032 (1953).

Li(α,$\alpha'\gamma$) E_α = 3.0
γ 0.478 scin

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93, 351 (1954).

Level Be^9 (d,$\alpha\gamma$)
(0.478) I = 1/2 α,γ(θ)

L.Cohen, S.S.Hanna, C.M.Class, Phys. Rev. 94, 419 (1954).

Levels Li(γ,p) scin
15.0
15.4
From activation curve for 0.83^{s}He^6

B.L.Tucker, C.E.Gregg, Phys. Rev. 93,362A (1954).

q negative ?
Calculation takes into account quadrupole moment induced in s electrons by nuclear q

R.M.Sternheimer, H.M.Foley, Phys. Rev. 92, 1460(1953); R.A.Logan, R.E.Coté, P.Kusch, Phys. Rev. 86, 280 (1952).

Li^8
3 5
0.9^s

Level Li^7 (d,p) E_d = 8
8.3† g.s. l_n = 1 d,p(θ)
†mb/sterad at 0°

J.R.Holt, T.N.Marsham, Proc. Phys. Soc. 66A,1032 (1953).

Li^9
3 6
0.17^s

τ 0.168^s C(≤270-Mev γ)

D.Reagan, Phys. Rev. 92, 651 (1953).

Be^8
4 4
~10^{-16}s

Level Be^9 (d,t) E_d = 1.16
g.s. graph of d,t(θ) ppl

M.K.Jurić, B.S.Marsicanin, Bull. Inst. Nuclear Sci., Boris Kidrich 3, 139 (1953).

Levels B(p,α) E_p = 1.98, 2.61
g.s.
2.9
No other levels found below 7 Mev (<10% g.s.)

R.Malm, D.R.Inglis, Phys. Rev. 92,1326(1953).

Level 0.9^{s}Li^8,0.7^{s}B^8 decay
2.9 I = 2* Γ = 1.2 ppl
*Or I = 4 if whole α spectrum (0 to 6-Mev) is used to fit single resonance theory

F.C.Gilbert, Phys. Rev. 93, 499 (1954).

Levels B(d,α) E_d = 1.0 ppl
2.9
4.9
7.2
Observed at 4 angles, ~15,000α's at each angle

P.Cüer, J.J.Jung, R.Bilwes, Compt. rend. 238, 1405 (1954).

Levels Li^7 (p,γ) E_p = 0.44
2.0%* (4.09) α ranges
1.9%* 5.31
0.5%* 7.51
*α pairs per γ from 17.63 level $\alpha\gamma$

E.K.Inall, A.J.F.Boyle, Phil.Mag. 44, 1081(1953).

Li(d,nγ) E_d = 0.65
4.9 level not found
γ's with E_γ = 4 to 8 not observed scin
~4.9γ previously reported from this reaction now attributed to C^{12}

R.M.Sinclair, Phys. Rev. 93, 1082 (1954).

B(γ,d) C(γ,α) E_γ = 17.6
4.9 level not found ppl
No three pronged stars with 4.9-Mev total energy deficit (from possible intermediate Be^8 4.9γ emitting state)

E.W.Titterton, Phys. Rev. 94, 206 (1954).

Levels He(α,α) E_α = 12.9 to 21.6
7.55 J = 0 Γ = 1.2
10.8 J = 4 Γ = 1.2
α,α(θ)

F.E.Steigert, M.B.Sampson, Phys. Rev. 92,660(1953).

Be^8 4 4 $\sim 10^{-16s}$ Levels Li(d,n) E_d = 0.4 to 4.7
16.70 Γ = 0.195
16.99 Γ = 0.350
17.63 narrow
18.14 wide
"Threshold" n's detected

T.W.Bonner, C.F.Cook, Phys. Rev. 94,807A(1954).

Level Li(p,p') E_p = 1.05 to 1.24
18.13 s
p,p' (θ,E_p) shows interference between levels of opposite parity

F.Mozer, W.A.Fowler, C.C.Lauritsen, Phys. Rev. 93, 829 (1954).

Level Li(p,γ) E_p = 0.88 to 1.24
18.13 scin
p, > 5-Mev $\gamma(\theta,E_p)$ shows interference between levels of opposite parity.

A.A.Kraus, Jr., Phys. Rev. 93, 1308(1954).

p, $\alpha(\theta)$ Li(p,α) E_p = 0.61, 0.71, 0.80
Coefficients of angular distribution given

D.K.Cartwright, L.L.Green, J.C.Willmott, Phil. Mag. 44, 1307 (1953).

Be^9 4 5 stable Q ~0.02 Mic

W.D.Knight, Phys. Rev. 92,539A(1953).

Be^{10} 4 6 2.5×10^{6y} Level Be^9(d,p) E_d = 1.16
g.s. graph of d,p(θ) ppl

M.K.Jurić, B.S.Marsicanin, Bull. Inst. Nuclear Sci., Boris Kidrich 3, 139 (1953).

Level Be^9(d,p) E_d = 8
g.s. l_n = 1 d,p(θ)

J.R.Holt, T.N.Marsham, Proc. Phys. Soc. 66A,1032 (1953).

Level Be^9(d,pγ) E_d = 0.84
3.37 I ≥ 2 p,$\gamma(\theta)$

L.Cohen, S.S.Hanna, C.M.Class, Phys. Rev. 94, 419 (1954).

Levels Be(d,p) E_d = 5.4 to 7.6

3.37	6.26	s
5.96	7.37	
~6.18*	7.52	

C.K.Bockelman, J.J.Jung, Phys. Rev. 94,748A (1954); * verbal report.

B^8 5 3 0.7^s B^8 and Li^8 decay to same levels of Be^8
~ 15% of decays go to Be^8 levels above 2.9
α range distribution in ppl
Be(375-Mev α)

F.C.Gilbert, Phys. Rev. 93, 499 (1954).

B^9 5 4 Levels Be^9(p,n)
~1.4 ? wide
2.36 narrow
"Threshold" n's detected

J.B.Marion, C.F.Cook, T.W.Bonner, Phys. Rev. 94, 807A (1954).

B^{10} 5 5 stable Level Be^9(d,n) recoil
γ (0.72) $\tau = 7\pm2\times10^{-10s}$

J.Thirion, V.L.Telegdi, Phys. Rev. 92,1253(1953).

Levels Be^9(d,n) E_d = 0.96 ppl

		l_p	
	g.s.	1	d,n(θ)
weak	0.72	1	
	1.74	1	
	2.15	1	
	3.58	1	

Distributions show combination of stripping and compound nucleus formation

J.S.Pruitt, C.D.Swartz, S.S.Hanna, Phys. Rev. 92, 1456 (1953); 91, 463A (1953).

Levels B^{10}(p,p') E_p ~7 sm
0.717 5
1.739 5
2.152 5
3.583 5
4.771 5
B^{10}(d,d')
1.74 level not observed

C.K.Bockelman, C.P.Browne, W.W.Buechner, A.Sperduto, Phys. Rev. 92, 665(1953); 90,340A(1953)

Levels Be^9(d,n) E_d = 0.4 to 4.7

4.78	6.04
5.11	6.16
5.17	6.61
5.93	

"Threshold" n's detected

T.W.Bonner, C.F.Cook, Phys. Rev. 94,807A(1954).

Levels Be^9(p,γ) E_p = 0.90 to 1.14
(7.48) J = 2− p,$\gamma(\theta)$
(7.56) J = 0+ p,$\gamma(\theta)$

E.B.Paul, H.E.Gove, Proc. Roy. Soc. Canada, 47, 145A (1953).

B^{10}
5 5
stable

Capture γ's $Be^9(p,\gamma)$ scin

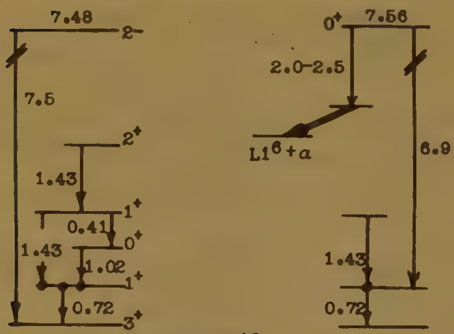
7.48 level $E_p = 0.993$ $\Gamma = 0.088$

0.26†	0.41	~0.3†	1.43
2.3 †	0.72	18.9†	7.5
0.6 †	1.02		

7.56 level $E_p = 1.085$ $\Gamma \sim 0.004$

≤0.008†	(0.41)	~0.05†	1.43
1.1 †	0.72	~0.15†	2.0-2.5
≤0.04 †	(1.02)	1.0 †	6.9

†Thick target γ yield per 10^9 protons



Stable B^{10}

W.F.Hornyak, T.Coor, Phys. Rev. 92,675(1953 91, 463A(1953).

Level $Be^9(p,\alpha\gamma)$ $E_p = 2.56$

(8.89) $J = 2+$, $T = 1$

Spin assignments deduced from σ

R.J.Mackin, Jr., Phys. Rev. 94, 648 (1954).

B^{11}
5 6
stable

Q +0.0355 2 M

G.Wessel, Phys. Rev. 92, 1581 (1953).

Level $B^{10}(d,p)$ $E_d = 1.43$ pc

g.s. $l_n = 1$ d,p(θ)

W.H.Burke, J.R.Risser, G.C.Phillips, Phys. Rev. 93, 188 (1954).

Levels $B^{10}(d,p)$ $E_d = 3.03$ ppl

g.s. $l_n = 1$ d,p(θ)

d,p(θ) for g.s. and first 3 levels shows large compound nucleus contribution

W.W.Pratt, Phys. Rev. 93, 816 (1954).

Level B(d,p) $E_d = 8$

g.s. $l_n = 1$ d,p(θ)

J.R.Holt, T.N.Marsham, Proc. Phys. Soc. 66A, 1032 (1953).

B^{11}
5 6
stable

Levels $B^{10}(d,p)$ $E_d = 8.06$ sr

$\Gamma < 0.010$ for first 5 levels

9†	7.99 1	
9†	8.57 1	
58†	8.93 1	
100†	9.19 1	
	9.28 1	
~60†	10.32 2	$\Gamma = 0.054$

† Rel. numbers of protons at 90°

M.M.Elkind, Phys. Rev. 92,127(1953); 91,463A(1953)

Levels $Be^9(d,n)$ $Be^9(d,p)$ $E_d = 0.96$

~16.7 $J = 3/2+$? d,n(θ)

~16.7 $J = 5/2-$ d,p(θ)

Strong cos θ terms superimposed on stripping patterns consistent with above spins

J.S.Pruitt, C.D.Swartz, S.S.Hanna, Phys. Rev. 92, 1456 (1953); 91, 463A (1953).

B^{12}
5 7
0.03^s

Levels $B^{11}(d,p)$ $E_d = 8.06$ sr

$\Gamma < 0.010$ for all levels

100†	g.s.
78†	0.95 1
285†	1.67 1
69†	2.62 1
4†	2.72 1
186†	3.38 1

†Rel. numbers of protons at 90°

M.M.Elkind, Phys. Rev. 92,127(1953); 91,463A(1953)

Levels B(d,p) $E_d = 8$ d,p(θ)

		l_n
7††	g.s.	1
11†	(0.95)	1
54†	(1.67)	0
25†	(3.38)	1
1††	(3.76)	1?
29†	(4.53)	2

†mb/sterad at 0° ††mb/sterad at 15°,35° resp.

J.R.Holt, T.N. Marsham, Proc. Phys. Soc. 66A 1032(1953).

B^{13}
5 8
?

τ $< 5\times10^{-8s}$ or $> 0.5^h$

No activity attributable to this nucleus found when various low and middle Z targets irradiated by 340-Mev p, 190-Mev d

E.L.Hubbard, L.Ruby, W.F.Stubbins, Phys. Rev. 92, 1494 (1953).

C^{11}
6 5
20.4^m

$B^{10}(d,n)$ $E_d = 0.7$ to 1.4

d,n(θ) shows $l_p = 1$ but neutron energies not determined long counter

W.H.Burke, J.R.Risser, G.C.Phillips, Phys. Rev. 93, 188 (1954).

C^{11}
6 5
20.4m

Resonances $B^{10}(p,\gamma)$ $E_p = 0.5$ to 1.7
0.78 broad
0.95?
1.33?

R.W.Krone, L.W.Seagondollar, Phys. Rev. 92, 935 (1953).

C^{12}
6 6
stable

Levels $Be^9(\alpha,n\gamma)$ $E_\alpha = 5.3$ scin
94† g.s.
6† 4.4
†From measured rates and efficiencies assuming above are only levels involved

D.E.Diller, M.F.Crouch, Phys. Rev. 93, 362A (1954).

Level N(d,α) $E_d = 0.62$
100† (4.43)
6† 7.68 3 $\Gamma < 0.025$ sm/2
No other level below 9.2 Mev (< 1†)

D.N.F.Dunbar, R.E.Pixley, W.A.Wenzel, W.Whaling, Phys. Rev. 92, 649,1095A(1953).

γ's $Be^9(\alpha,n\gamma)$ $E_\alpha = 5.3$
(4.43) E2, M1 $e^+e^-(\theta)$ cc
~7 0→0(7 pairs observed)

G.Harries, Proc. Phys. Soc. 67A, 153(1954).

$B^{11}(d,n)$ $E_d = 0.7$ to 1.6
d,n(θ) shows $l_p = 1$ but neutron energies not determined long counter

$B^{10}(d,n)$ $E_d = 0.2$ to 2.0
No resonances observed long counter

Resonances $B^{10}(d,p)$; $B^{10}(d,p\gamma)$
~1.0 ? pc
~1.5 ?

W.H.Burke, J.R.Risser, G.C.Phillips, Phys. Rev. 93, 188 (1954).

$C(\gamma,\alpha)Be^8$ $E_\gamma = 17.6$ ppl
$C(\gamma,3\alpha)$
α energy distribution from 109 stars suggests both reactions take place

R.Chastel, J. Phys. radium 15, 240 (1954).

Levels $B^{10}(\alpha,p)$ $E_\alpha = 1$ to 2 s
α,p(θ)

	J
g.s.	$1/2^-$
3.13	$1/2^+$
3.72	$3/2^-$
3.86	$5/2^+$

No 0.7 level (< 7% of g.s. protons)
0.21 γ observed, interperted as 30% branch from 3.9 to 3.7 level
Yield proton groups given for 7 α energies

E.S.Shire, J.R.Wormald, G.Lindsay-Jones, A.Lundén, A.G.Stanley, Phil. Mag. 44, 1197(1953).

C^{13}
6 7
stable

B(α,p) $E_\alpha = 5.3$
No 0.7 level apγ

J.Thirion, Ann. Phys. 8, 489 (1953).

Levels $B^{10}(\alpha,p)$ $E_\alpha = 4.8$, 5.8 s
3.09
3.68
3.8
No 0.70 level (p yield < 1% of g.s. group)*
No 4.6 level (p yield < 1% of 3.85 level group)*

W.J.Fader, A.Sperduto, Phys. Rev. 94, 748A (1954); * verbal report.

Levels $B^{10}(\alpha,p\gamma)$
(3.68) $I = 3/2^-$* pγ(θ)
(3.89) $I = 5/2^+$
$E_\alpha = 1.31$, 1.51, 1.64, 1.83
*0.21 γ (from 3.89 to 3.68 level) is E1 pγ(θ)

A.G.Stanley, Phil. Mag. 45, 430 (1954).

γ's C(d,pγ) $E_d = 2.4$
0.168 sl pe^-
45† (3.08) sl Cpt
5† 3.67
4† 3.83

R.J.Mackin, Jr., Phys. Rev. 92, 529A(1953).

Level C(n,n) $E_n = 2.08$; scin
(6.87) $J = 3/2^+, 5/2^+$ n,n(θ)

R.Ricamo, Nuovo Cim. 10, 1607(1953).

Levels $Be^9(\alpha,n)$; $Be^9(\alpha,n\gamma)$
11.02 $E_\alpha = 0$ to ~2
11.08
12.0

W.E.Bennett, P.A.Roys, B.J.Toppel, Phys. Rev. 93, 924A (1954).

Levels $Be^9(\alpha,n)$ $E_\alpha = 1.0$ to 3.5
11.98 long counter
12.21
12.44
13.01

R.E.Trumble, Jr., Phys. Rev. 94, 748A (1954).

$B^{11}(d,n)$ $E_d = 0.2$ to 2.0
No resonances observed long counter

W.H.Burke, J.R.Risser, G.C.Phillips, Phys.Rev. 93, 188 (1954).

C^{14} 6 8 ~5600y

Level $C^{13}(d,p)$ $E_d = 0.28$ to 0.64
g.s. $l_n = 1$ d,p(θ)
Reaction proceeds mainly by stripping

B. Koudijs, F.P.G.Valckx, P.M.Endt, Physica 19, 1133 (1953).

$C^{13}(d,p\gamma)$ $E_d = 1.9$
γ 6.12 sl Cpt
6.73
Values without Doppler corrections
No additional γ's at $E_d = 2.6$

R.J.Mackin, Jr., W.B.Mims, W.R.Mills, Phys. Rev. 93, 950A (1954).

C^{15} 6 9 2.4s

Level $C^{14}(d,p)$
g.s. I = 5/2 ? from σ curve

J.A.Rickard, E.L.Hudspeth, Phys. Rev. 94, 806A (1954).

τ 2.4s C^{14} (2-Mev d)
γ ~5.3 scin
Several weak γ's with $E_\gamma > 5.3$

K.R.Spearman, E.L.Hudspeth, I.L.Morgan, Phys. Rev. 94, 806A (1954).

N^{13} 7 6 10.1m

Levels N(p,d) $E_p = 18.7$ scin
g.s. $l_n = 1$ p,d(θ)
d group to N^{13} 2.37 level not found
(< 4%, 15% of g.s. group if $l_n = 0, 2$)

K.G.Standing, Phys. Rev. 94, 731 (1954).

Level C(p,p) $E_p = 0.3$ to 0.6
2.370 $\Gamma = 0.032$ p,p(θ)

E.A.Milne, Phys. Rev. 93, 762 (1954).

Levels $C^{12}(p,\gamma)$ $E_p = 1$ to 3 scin
(2.37)
Capture γ to 2.37 level observed as f(E_p)
2.37 level decays mainly to $C^{12} + p$
(3.511) Γ_γ (1.14γ) = 0.04ev
(Γ_γ(3.51γ) = 0.7ev)
$\gamma(E,\theta)$ near this resonance explained as due to interference between non-res. capture γ and res. radiation

H.H.Woodbury, A.V.Tollestrup, R.B.Day, Phys. Rev. 93, 1311 (1954).

Levels C(p,p) $E_p = 2$ to 7
~4.9 a
~6.4
C(p,p'γ) $E_p = 2$ to 7
6.90 a
7.40

H.Martin, H.Schneider, H.Sempert, Helv. Phys. Acta 26, 595A (1953).

N^{14} 7 7 stable

Levels O(d,α) $E_d = 19$ ppl
2.6† g.s.
<0.1† (2.31)
†Total σ in mb

R.G.Freemantle, W.M.Gibson, D.J.Prowse, J.Rotblat, Phys. Rev. 92, 1268 (1953).

Levels N(p,p') $E_p \sim 7$ sm
2.313 *5*
3.945 *5*
4.91 *1*
5.10 *1*
N(d,d')
2.31 level not observed

C.K.Bockelman, C.P.Browne, W.W.Buechner, A.Sperduto Phys. Rev. 92, 665 (1953); 90, 340A (1953).

$C^{13}(d,n\gamma)$ $E_d = 1.4$, 1.9
γ w 3.91 sl Cpt
4.93
5.13
5.73
6.45*
No 5.82γ, (<14% of 5.73γ at $E_d = 1.42$)
No additional γ's at $E_d = 2.6$
*Not observed at $E_d = 1.4$
Values without Doppler correction

R.J.Mackin, Jr., W.B.Mims, W.R.Mills, Phys. Rev. 93, 950A (1954).

Levels $C^{13}(p,p)$ $E_p = 0.45$ to 1.60

	J	
(8.06)	1−	p,p(θ)
(8.62)	0+	
(8.70)	0−	
8.90	3−?	
8.98	1+?	

E.A.Milne, Phys. Rev. 93, 762 (1954); 92, 1085A (1954).

Capture γ's $C^{13}(p,\gamma)$ scin
8.06 level $E_p = 0.55$ T = 1 > 98%

2.307	<0.7†	(5.70)
4.11	100†	8.06

A.B.Clegg, D.H.Wilkinson, Phil. Mag. 44, 1269, (1953).

γ's $C^{13}(d,n\gamma)$ scin
5.69 level (3.38γ) (2.31γ)
5.81 level (0.73γ) (4.5–5.2γ)

Capture γ's $C^{13}(p,\gamma)$ scin
8.06 level $E_p = 0.55$ $\Gamma = 0.033$

7.3†	1.63	15†	4.0
7.3†	2.32	89†	8.0

8.62 level $E_p = 1.16$ $\Gamma = 0.006$

39†	1.64	59†	4.7
66†	2.33	27†	6.25
20†	3.94	14†	8.6

N^{14}
7 7
stable

8.70 level $E_p = 1.25$ $\Gamma = 0.5$

≥ 90†	8.7

8.90 level $E_p = 1.47$ $\Gamma = 0.02$

65†	0.731	100†	3.09
17†	2.32	48†	5.1
17†	2.8	35†	5.7

8.98 level $E_p = 1.55$ $\Gamma = 0.007$

≥ 85†	9.0

9.17 level $E_p = 1.76$ $\Gamma = 0.0021$

10†	2.73	90†	9.2
10†	6.5		

9.49 level $E_p = 2.10$ $\Gamma = 0.045$

26†	2.32	100†	4.41
26†	2.78	74†	5.09

H.H.Woodbury, R.B.Day, A.V.Tollestrup, Phys. Rev. 92, 1199 (1953).

Levels	$B^{10}(\alpha,p)$ J	$B^{10}(\alpha,d)$ Γ
12.42	4⁻	0.043
12.50		0.036
12.61		0.050
12.69	3⁻	0.014*
12.78	4+	0.014*
12.81	4⁻	0.005
12.92	4+	0.021

No capture γ's scin
Yield p and α groups given for 7 α energies
*All partial Γ's also given $E_\alpha = 1$ to 2

E.S.Shire, J.R.Wormald, G.Kindsay-Jones, A.Lundén, A.G.Stanley, Phil. Mag. 44, 1197 (1953).

Levels $B^{10}(\alpha,p\gamma)$ $E_\alpha = 1.13$ to 1.64 p, γ(θ)

12.42 J = 3−
12.69 J = 4+
12.78 J = 4+

Distribution of 0.2 and 3.7+3.9 C^{13} γ's consistent with above spins

A.G.Stanley, Phil. Mag. 45, 430 (1954).

Level N(d,p) $E_d = 0.4, 0.5, 0.6$
(g.s.) $l_n = 1$ d,p(θ)

Position of minimum agrees with stripping theory but high yield shows compound nucleus formation important

H.M.Jongerius, F.P.G.Valckx, P.M.Endt, Physica 20, 29 (1954).

N^{15}
7 8
stable

Levels N(n,p)		N(n,α)	
11.26	12.37	11.91	13.21
11.41	12.46	11.99	13.49
11.78	12.65	12.10	13.61
11.91	12.90	12.17	13.74
12.02	13.01	12.39	13.85
12.12		12.49	13.95
		12.63	14.01
		12.86	14.14
		12.96	
		RaBe n	ic

G. von Gierke, Z.Naturf. 8a, 567 (1953).

Levels	B(α,n)	$E_\alpha = 1.0$ to 3.5 long counter
	12.12	13.19
	12.52	13.38
	12.92	

R.E.Trumble, Jr., Phys. Rev. 94, 748A (1954).

Capture γ's $C^{14}(p,\gamma)$ $E_p = 1$ to 2
~5 scin
Other γ's with $E_\gamma \leq 10$ Mev

K.R.Spearman, E.L.Hudspeth, I.L.Morgan, Phys. Rev. 94, 806A (1954).

$O^{18}(p,\alpha)$ $E_p = 0.4$ to 0.7
No γ scin

R.R.Roy, A.Lagasse, M.J.Decock, Phil. Mag. 44, 1189 (1953).

N^{16}
7 9
7.4s

τ 7.38s O(12-Mev n)

M.C.Martin, Phys. Rev. 93, 498 (1954).

Level $C^{14}(d,p)$ $E_d = 0.6$ to 3.0
12.6 Γ~0.40

J.A.Rickard, E.L.Hudspeth, Phys. Rev. 94, 806A (1954).

O^{14}
8 6
77s

β^- 100† 1.83 N(p,n); βγ scin
3†? (4.14)

J.R.Penning, F.H.Schmidt, Phys. Rev. 94, 779A (1954).

Levels N(p,n) $E_p = 17.3$ ppl
5.2
7.5 } wide or unresolved
9.3

No levels 0 to 5.5 (n yield <25% of g.s. group)

F.Ajzenberg, W.Franzen, Phys. Rev. 94, 409 (1954).

O^{15} 8 7 2.0^m

Levels N(p,p) $E_p = 1.3$ to 1.9
8.78 J = 1/2+ p,p(θ)
8.95 J = 3/2-?
9.01

H.E.Gove, A.J.Ferguson, J.T.Simple, Phys. Rev. 93, 928A(1954).

O^{16} 8 8 stable

γ $F^{19}(p,\alpha\gamma)$ $E_p = 0.84$
(6.05) 0 ⟶ 0 $e^+e^-(\theta)$ G-M

S.Devons, G.Goldring, G.R.Lindsey, Proc. Phys. Soc. 67A, 134 (1954).

Levels O(p,p') $E_p = 9.5$ ppl
(6.05) (6.9)
(6.13) (7.1)

W.E.Burcham, W.M.Gibson, A.Hossain, J.Rotblat, Phys. Rev. 92,1266(1953).

Levels $F^{19}(p,\alpha\gamma)$ $E_p = 0.87$

	J
(6.13)	3-
(6.9)	2^+
(7.1)	1^-

γ polarization studied by D(γ,p)

L.W.Fagg, S.S.Hanna, Phys. Rev. 92,372(1953); 88, 1205(1952).

Levels C(α,α) $E_\alpha = 4$ to 6
~10.3 J = 4+ pc
11.1 narrow $\alpha,\alpha(\theta)$
~11.5 J = 2+ broad

W.Haeberli,J.W.Bittner, R.D.Moffat, Phys. Rev. 94, 769A (1954).

Levels $N^{15}(p,\alpha)$ $E_p = 0.23$ to 0.96
12.43 J = 0^+ $p,\alpha_0(\theta)$
13.09 J = 1^-

A.V.Cohen, A.P.French, Phil. Mag. 44, 1259(1953).

O^{17} 8 9 stable

Levels O(d,p) $E_d = 19$ ppl
36† g.s. $l_n = 2$ d,p(θ)
23† (0.88) $l_n = 0$
†Total σ in mb

R.G.Freemantle, W.M.Gibson, D.J.Prowse, J.Rotblat, Phys. Rev. 92,1268(1953).

Level O(d,p) $E_d = 1.66$ to 2.2 ppl
(0.88) $l_n = 0$ d,p(θ)

A.Berthelot, R.Cohen, E.Cotton, H.Faraggi, T.Grjebine, A.Levêque, V.Magglar, M.Roclawski-Conjeaud, D.Szteinsznaider, Compt. rend. 238, 1312 (1954).

$_8O^{17}_9$ stable

Level O(d,n) recoil
(0.88) $\tau = 2.5 \pm 1.0 \times 10^{-10s}$

J.Thirion, V.L.Telegdi, Phys. Rev. 92,1253(1953).

Level N(α,p) $E_\alpha = 5.30$ ppl
0.86

E.Hjalmar, H.Slätis, Arkiv Fysik 6,451(1953).

Level Ne(n,α)
0.87 ic

F.C.Flack, J.B.Warren, Proc. Roy. Soc. Canada, 47, 131A(1953).

Levels O(n,n) $E_n = 0.39$ to 1.4
4.56 J = 3/2 - n,n(θ)
5.08 J = 3/2+ O recoil
5.39 J = 3/2 -

R.K.Adair, Phys. Rev. 92, 1491 (1953).

Levels O(n,α)

6.55	7.28
6.79	7.43
6.96	7.63
7.11	

Li(d,n) ic

K.Kimura, R.Ishiwari, M.Sakisaka, I.Kumabe, S.Yamashita, K.Miyake, Bull. Inst. Research, Kyoto. Univ. 31,204(1953); Chem. Abstr. 47-10358g(1953).

Levels O(n,α)

6.83	7.85	9.76	11.36
6.89	7.98?	10.07	11.49
6.99	8.23	10.25?	11.61?
7.11	8.62	10.39	11.84
7.35	8.84	10.57	12.03
7.48	9.09	10.85	12.25
7.63	9.34	11.07?	12.47
7.71	9.57?	11.17	12.73?

RaBe n ic

G. von Gierke, Z. Naturf. 8a, 567 (1953).

Levels C(α,n) $E_\alpha = 0$ to 2
7.158 *9* $\Gamma \sim 0.008$ scin
7.372 *11*

G.A.Jones, D.H.Wilkinson, Proc. Phys. Soc. 66A, 1176 (1953).

Levels $C^{13}(\alpha,n)$ $E_\alpha = 1.0$ to 3.5
[redacted] long counter
8.45
[redacted]

R.E.Tramble, Jr., Phys. Rev. 94, 748A (1954).

F^{17} 9 8 70^s

τ	66^s	O(13-Mev d)	
β^+	1.76		a
No γ ($E_\gamma/\beta <$ 0.1 Mev)			a

L.Koester, Z.Naturf. 9A, 104 (1954).

β^+	1.749		sl
No 0.88 β^+ (< 1%)	No γ		

C.Wong, Phys. Rev. 92, 529A(1953).

F^{18} 9 9 1.87^h

Levels	N(α,p)	E_α = 1.5 to 3.5	
		Γ	
0.3†	6.694	0.027	pc
5†	6.854	0.093	
	~7.1	~0.46	

$\alpha\alpha$ elastic resonances consistent with above levels

†Percent of elastic scattering

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 92,89(1953)

	O(d,γ)	E_d = 1.1	
No capture γ's (σ < 0.5mb)			scin

R.M.Sinclair, Phys. Rev. 93, 1082 (1954).

F^{19} 9 10 stable

Levels	F^{19}(p,p'γ)		
	0.114*	$\tau \sim 10^{-9s*}$	recoil
	0.198*	$\tau \sim 10^{-7s*}$	

No 0.084γ (<1%)*

R.W.Peterson, C.A.Barnes, W.A.Fowler, C.C. Lauritsen, Phys. Rev. 93,951A(1954); *verbal report.

Levels		F^{19}(α,$\alpha'\gamma$)	E_α = 1.20	
γ	0.35†	0.112		scin
	1.4 †	0.195		

†Thick target yield per 10^{10} α's

G.A.Jones, D.H.Wilkinson, Phil. Mag. 45, 230 (1954).

Levels	F^{19}(α,$\alpha'\gamma$)	E_α = 3.0	
γ	0.108		scin
	0.196		

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93,351 (1954).

Levels	O^{18}(d,n)	E_d = 2	ppl
	0.2	3.85	
	0.9	4.5	
	1.4	4.8	
	1.6	5.2	
	2.2	5.5	
	2.75		

R.L.Seale, Phys. Rev. 92, 389 (1953).

F^{20} 9 11 12^s

β^+	5.42	F-K plot linear	sl
γ	1.627		

C.Wong, Phys. Rev. 92, 529A(1953).

Ne^{18} 10 8 1.6^s

τ	1.6^s		F^{19}(24-Mev p)
β^+	3.2	log ft = 2.9	sπ

J.D.Gow, L.W.Alvarez, Phys. Rev. 94,365(1954).

Ne^{20} 10 10 stable

	Ne(p,p'γ)	E_p = 1.35 to 4.4	
No 2.2γ			scin

M.C.Cox, J.J.vanLoef, D.A.Lind, Phys. Rev. 93, 925A(1954).

Levels	F^{19}(p,α)		
	13.44	Γ_γ^* < 2 ev	scin
	13.70	Γ_γ^* < 15 ev	

*From intensity of Ne^{20} 12-Mev γ relative to O^{16} 6- and 7-Mev γ's

D.H.Wilkinson, A.B.Clegg, Phil. Mag. 44, 1322 (1953).

Levels	F^{19}(p,12-Mev γ)		
		Γ (kev)	E_p = 0.62 to 1.65
	13.505	7.5	scin
	13.908	< 1.2	
	14.128	4.0	
	14.230	15.7	

R.M.Sinclair, Phys. Rev. 93, 1082 (1954).

Levels	F^{19}(p,p' 0.114γ)
	13.683*
	13.907*
	(14.157)
	(14.182)
	14.218

Level	F^{19}(p,p)	E_p = 1.419
	14.218	J = 1+

R.W.Peterson, C.A.Barnes, W.A.Fowler, C.C. Lauritsen, Phys. Rev. 93,951A(1954), *verbal report.

Levels	F^{19}(p,$\alpha\gamma$)		
	(13.759)	J = 1+	p,6.14γ(θ)
	(14.182)	J = 2−	p,6.9γ+7.1γ(θ)

(6.14γ)/(6.9γ+7.1γ) = 8.7 at 90° E_p = 1.381

J.E.Sanders, Phil. Mag. 44, 1302 (1953).

Ne^{21}
10 11
stable

Levels Ne(n,α)

8.13	9.39	10.81	12.38
8.27	9.48	11.02	12.64?
8.45	9.68	11.17	12.83
8.59?	9.86	11.30	12.98
8.71	10.33	11.49	13.10?
9.00	10.47	11.60	13.32?
9.10	10.60?	11.90	13.42
9.18			

RaBe n ic

G. v. Gierke, Z. Naturf. 9A, 164 (1954).

Levels Ne(n,α)

9.85	10.85	11.27
10.08	10.90	11.38
10.32	11.04	11.44
10.48	11.12	11.49
10.72	11.20	11.60

Assuming $B_n(Ne^{20}) = 6.756$

F.C.Flack, J.B.Warren, Proc. Roy. Soc. Canada 47, 131A (1953).

Ne^{22}
10 12
stable

Ne(p,p′γ) $E_p = 1.35$ to 4.4
No 0.4γ scin

M.C.Cox, J.J.vanLoef, D.A.Lind, Phys. Rev. 93, 925A (1954).

Levels $F^{19}(\alpha,p\gamma)$ $E_\alpha = 7.6$

1.28 level

γ 1.28 pγ scin

3.3 level

γ 75† 1.28 pγ scin
75† 2.1 25† 3.4

4.9 level

γ 50† 1.28 ~50† 4.9 pγ scin
50† 3.6

No 1.5 γ (<5†)

B.P.Foster, G.S.Stanford, L.L.Lee, Jr., Phys. Rev. 93, 1069 (1954); 94, 804A (1954).

Na^{21}
11 10
23^s

Levels Ne(p,p′1.64γ) $E_p = 1.35$ to 4.4 scin

4.33	5.73
4.44	5.84
4.50	5.85
5.05	6.11
5.49	6.26

M.C.Cox, J.J.vanLoef, D.A.Lind, Phys. Rev. 93, 925A (1954).

Na^{22}
11 11
2.6^y

ε 9.9±0.6% $\beta^+\gamma$

Theoretical value for allowed transition = 10.2%

R.Sherr, R.H.Miller, Phys. Rev. 93, 1076 (1954); 92, 848A (1953).

Na^{22}
11 11
2.6^y

ε 7±2%

W.F.Hornyak, T.Coor, Phys. Rev. 92,675 (1953).

$\beta^+/1.28\gamma = 0.89 \pm 0.05$ scin

D.Maeder, R.Müller, V.Wintersteiger, Helv. Phys. Acta 27, 3 (1954).

Na^{23}
11 12
stable

$Na^{23}(\alpha,\alpha'\gamma)$ $E_\alpha = 3.0$
γ 0.446* scin

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93,351 (1954); *priv. comm.

Na^{24}
11 13
15.0^h

Levels $Na^{23}(d,p)$ $E_d = 3.0$

	l_n
g.s.	2
(0.472)	0 and 2
(0.564)	0 and 2
(1.341)	0

P.Shapiro, Phys. Rev. 93, 290 (1954).

Mg

γ Mg(n,n′γ) $E_n = 14$ scin
1.4 n′γ

R.E.Garrett, F.L.Hereford, B.W.Sloope, Phys. Rev. 92, 1507 (1953); 91,441A (1953).

Mg(α,α′γ) $E_\alpha = 3.0$
No γ scin

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93,351 (1954).

Mg^{24}
12 12
stable

Resonances $Na^{23}(p,\gamma)$
0.3022 *6* Γ < 50 ev
0.5945 *15* Γ ~ 400 ev

D.M.Turner, Australian J. Sci. Res. 6,380, (1953).

Capture γ's $Na^{23}(p,\gamma)$ $E_p = 0.3022$ scin

~25†	0.41	4†	6.2
≤30†	0.63	3†	6.8
~50†	0.80	6†	7.2
~70†	1.38	44†	7.73
20†	2.86	~1†	8.5
14†	3.43	13†	9.2
18†	3.89	7†	9.9
28†	4.30	13†	10.6
~2†	5.3	4†	11.2
~3†	5.8	23†	11.8

γγ coincidences support decay scheme

D.M.Turner, Australian J. Sci. Res. 6,380, (1953).

Mg^{24} 12 12 stable

Levels Ne(α,α) E_α = 2 to 4 pc
See also Mg^{26}

	J	Γ (kev)
11.405	1−	α,α(θ)
11.476	0+	
11.542	2+	
11.751	0+	10
11.883	1−	8
11.985	2+	
12.288	3−	
12.481	1−	7
12.499	2+	5
12.531	4+	
12.601	2+	6

E.Goldberg, W.Haeberli, A.I.Galonsky, R.A.Douglas, Phys. Rev. 93, 799 (1954).

Levels Na^{23}(p,γ) E_p = 0.85 to 1.70

		Γ	γ's
6†	12.67	0.004	
9†	12.68	0.006	
8†	12.75	0.010	
16†	12.82	0.004	
12†	12.86	0.004	
14†	12.90	0.004	
57†	12.93	0.008	1.6
	12.97		1.4, 11.6
104†	12.98	0.010	1.6
12†	13.04	0.004	4.5, 8.5
12†	13.06	0.004	1.4, 2.8, 9.0
118†	13.10	0.012	1.6
353†	13.28	0.033	1.6

J.W.Teeher, L.W.Seagondollar, R.W.Krone, Phys. Rev. 93, 1035 (1954).

Mg^{26} 12 14 stable

Levels Ne(α,α) E_α = 2 to 4 pc
13.388 J = 3− Γ = 2.5 kev
13.534 J = 3− Γ = 3.2 kev
Assignment based on relative intensities and isotopic abundances α,α(θ)

E.Goldberg, W.Haeberli, A.I.Galonsky, R.A.Douglas, Phys. Rev. 93, 799 (1954).

Mg^{27} 12 15 9.5m

E_γ/β = 0.88 ± 0.08 Mev a
Confirms decay scheme of Daniel et al. Z. Naturf. 8A, 447 (1953)

L.Koester, Z.Naturf. 9A, 104 (1954).

Mg^{28} 12 16 21.4h

β^- 0.459 F-K plot linear sl
Cl(340-Mev p) chem

J.L.Olsen, G.D.O'Kelley, Phys. Rev. 93, 1125 (1954).

Al^{24} 13 11 2.1s

γ 7.1 Mg(20-Mev p) scin
Four lower energy γ's
α's

N.W.Glass, J.R.Richardson, Phys. Rev. 93, 942A (1954).

Al^{26} 13 13 6.7s

Resonances Mg^{25}(p,γ)6.7sAl^{26}
E_p = 0.3 to 1.2

0.39	0.81
0.49	0.88
0.51	0.93
0.56	0.99
0.59	1.04
0.65	1.08
0.68	1.10
0.72	1.13
0.78	1.20

W.E.Taylor, L.N.Russell, J.N.Cooper, Phys. Rev. 93, 1056 (1954).

Al^{27} 13 14 stable

No γ Al^{27}(α,α′γ) E_α = 3.0 scin

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93, 351 (1954).

γ's. Al^{27}(n,n′γ) E_n = 14 scin n′γ
0.82
1.02
2.34

R.E.Garrett, F.L.Hereford, B.W.Sloope, Phys. Rev. 92, 1507 (1953); 91, 441A (1953).

Capture γ's Mg(p,γ) scin

8.68 level	E_p = 0.454
0.81	5.7
2.3	6.5
2.8	7.9
4.1	8.7
4.6	

J.C.Kluyver, G.Verploegh, Physica 20, 178 (1954).

Capture γ's Mg(p,γ) scin

8.68 level	E_p = 0.449
0.8	5.9
2.8	8.0
8.90 level	**E_p = 0.660**
0.8	5.5
1.0	6.2
2.8	8.0
9.23 level	**E_p = 1.011**
0.8	6.2
1.0	8.5
2.8	
9.27 level	**E_p = 1.053**
0.8	6.7
1.0	8.65
2.7	9.3
5.6	

J.A.Smith, J.N.Cooper, J.C.Harris, Phys. Rev. 94, 749A (1954); verbal report.

Al^{28} 13 15 2.3^{m}
β^- 2.88 d 21.4^{h}Mg; sl
< 0.8% (4.66)

J.L.Olsen, G.D.O'Kelley, Phys. Rev. 93, 1125 (1954).

Si
Si($\alpha,\alpha'\gamma$) E_α = 3.0
No γ scin

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93,351 (1954).

Si^{28} 14 14 stable
Level Al^{27}(p,γ) E_p = 0.65 to 2.2
(1.78) I = 2+ or 3+ p,γ(θ)

H.E.Gove, E.B.Paul, G.A.Bartholomew, A.E.Litherland, Phys. Rev. 94, 749A(1954); verbal report.

Capture γ's Al^{27}(p,γ) scin

11.99 level E_p = 0.404 J = 4−
1.13 ? 2.8 7.3
1.84 5.1 10.2
(p),(7.3γ)(θ) b = + 0.31 No α's observed*

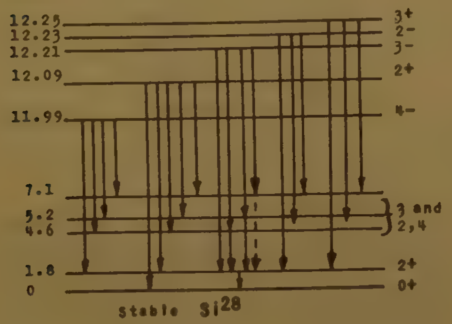
12.09 level E_p = 0.503 J = 2+
1.18 ? 2.8 7.3 12.1
1.84 5.1 10.3
(p),(10.3γ)(θ) b = 0 α emitting level*

12.21 level E_p = 0.630 J = 3−
1.13 ? 2.8 5.1 10.4
1.84 3.5 7.6
(p),(10.4γ)(θ) b = −0.11 α emitting level*

12.23 level** E_p = 0.652 J = 2−
5.1 7.5 10.4 12.2
(p),(7.5γ)(θ) b = −0.48 No α's observed*
(p),(10.4γ)(θ) b = −0.12

12.25 level** E_p = 0.677 J = 3+
7.5 10.4
(p),(10.4γ)(θ) b = 0 No α's observed*

*α yield data of J.G.Rutherglen, R.D.Smith, Proc. Phys. Soc. 66A, 800 (1953).
**Low energy γ spectrum not measured



J.G.Rutherglen, P.J.Grant, F.C.Flack, W.M.Deuchars, Proc. Phys. Soc. 67A,101(1954).

Si^{29} 14 15 stable
I 1/2 $Si^{29}F_4$ I

G.A.Williams, D.W.McCall, H.S.Gutowsky, Phys. Rev. 93, 1428 (1954).

I 1/2 S

R.A.Ogg, Jr., J.D.Ray, J. Chem. Phys. 22, 147, (1954).

I 1/2 Mic
Q <1x10^{-4}

R.L.White, C.H.Townes, Phys. Rev. 92,1256(1953).

Si^{31} 14 17 2.65^{h}
γ 0.07% 1.26 scin
No lower energy γ's Si(pile n) chem

W.S.Lyon, J.J.Manning, Phys. Rev. 93,501(1954).

Si^{32} 14 18 ~700^{y}
D 14.3^{d}P, chem Si(pile n)
$\tau(Si^{32})$ = 600 $\sigma[Si^{31}$(pile n,γ)] years

A.Turkevich, A.Samuels, Phys. Rev. 94,364(1954)

P^{28} 15 13 0.28^{s}
β+ 10.6 Si(20-Mev p) scin
γ 7.6
Six or seven lower energy γ's
No heavy particles

N.W.Glass, J.A.Richardson, Phys. Rev. 93,942A (1954).

P^{29} 15 14 4.6^{s}
β^+ 3.945 Si(3-Mev d); sl
~3% ~2.6
γ 1.5% (1.28)

H.Roderick, C.Wong, Phys. Rev. 92, 204(1953).

P^{30} 15 15 2.5^{m}
τ 2.55^{m} S(13-Mev d)
β^+ 3.23 a
No γ (E_γ/β< 0.1 Mev) a

L.Koester, Z.Naturf. 9A, 104 (1954).

τ 2.5^{m} P^{31} (≤ 30-Mev γ)
No γ scin
No shorter lived activity observed

P.Stähelin, Helv. Phys. Acta 26,691(1953).

P^{31} 15 16 stable
Resonances Al^{27}(α,p) cc
(4.0) Γ = 0.36
(4.4) Γ = 0.30

R.R.Roy, C.Godeau, Phil. Mag. 44,1184(1953).

P^{31} 15 16 stable

$P^{31}(\alpha,\alpha'\gamma)$ $E_\alpha = 3.0$

No γ scin

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93,351 (1954).

P^{32} 15 17 14.3^d

Inner bremsstrahlung spectrum (0.08 to 0.9) has allowed shape

W.Goodrich, W.B.Payne, Phys. Rev. 94,405(1954).

P^{33} 15 18 24.4^d

τ 24.4^d S^{33}(pile n) chem

β^- 0.249 sl

R.T.Nichols, E.N.Jensen, Phys. Rev. 94, 369 (1954).

S

$S(\alpha,\alpha'\gamma)$ $E_\alpha = 3.0$

No γ scin

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93,351 (1954).

S^{32} 16 16 stable

Capture γ's $P^{31}(p,\gamma)$ $E_p = 0.4$ to 1.2 scin

9.4 level

0.7 2.2 5.0 8.0
1.4 3.8 7.4

9.5 level

2.2 4.3 5.5 7.6

9.6 level

0.6 3.9 5.4 7.6
2.2

9.95 level

2.2 5.3 8.0 10.1
4.5

9.98 level

2.2 4.4 5.5 8.0

J.A.Smith, J.N.Cooper, J.C.Harris, Phys. Rev. 94, 749A (1954); verbal report.

S^{33} 16 17 stable

Level $A^{36}(n,\alpha)$ $E_n = 2.15$ to 4.40

0.9 pc

(Incorrectly given as 1.1 in NSA 7 No. 24B)

B.J.Toppel, S.D.Bloom, Phys. Rev. 91,473A(1953).

S^{35} 16 19 87^d

No β^-'s with $E_\beta < 10$ kev found from $C_2H_5S^{35}H$ in cc

G.J.Plain, H.L.Morrison, P.H.Pitkanen, F.T. Rogers, Jr., Phys. Rev. 92,529A(1953).

μ 1.00 OCS^{35} Mic

Assumed positive

B.F.Burke, M.W.P.Strandberg, V.W.Cohen, W.S. Koski, Phys. Rev. 93, 193 (1954).

Cl

$Cl(\alpha,\alpha'\gamma)$ $E_\alpha = 3.0$

No γ scin

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93,351 (1954).

Cl^{32} 17 15 0.31^s

β^+ 9.4 S(20-Mev p) scin

γ 4.77

Three lower energy γ's

α's

N.W.Glass, J.R.Richardson, Phys. Rev. 93,942A (1954).

Cl^{33} 17 16 2.8^s

γ ~0.3% 2.85*

W.E.Meyerhof, G.Lindstrom, Phys. Rev. 93, 949A(1954); *verbal report.

Cl^{34} 17 17 1.5^s

τ_2 1.58^s d 32.4^mCl chem

W.Arber, P.Stähelin, Helv. Phys. Acta 26,584A,691 (1953); Phys. Rev. 92, 1076(1953).

Cl^{35} 17 18 stable

$\nu(Cl^{35})/\nu(Cl^{37}) = 1.2684$ *1* $HgCl_2$ quad res

H.G.Dehmelt, H.G.Robinson, W.Gordy, Phys. Rev. 93, 480(1954); 93, 920A(1954).

A^{37} 18 19 34^d

E_{dis} 0.82 scin

From continuous γ endpoint

S.E.Singer, W.S.Emmerich, J.D.Kurbatov, Phys. Rev. 94,113,779A(1954).

A^{38} 18 20 stable

Levels $Cl^{35}(\alpha,p)$ $E_\alpha = 7.45$

2.13 a

3.73

A.Z.Kranz, W.W.Watson, Phys. Rev. 91,1472(1953).

K

$K(\alpha,\alpha'\gamma)$ $E_\alpha = 3.0$

No γ scin

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93,351 (1954).

K^{38} 19 19 0.95^s

τ_2 0.95^s $K(\leq 31\text{-Mev } \gamma)$

β^+ (4.57)*

$\sigma(0.95^sK)/\sigma(7.7^mK) = \sim 1$ $E_\gamma \leq 16$ to $E_\gamma \leq 31$

Suggest this is $J = 0^+$ and $T = 1$ state

*Formerly assigned to K^{37}

P.Stähelin, Helv. Phys. Acta 26,691(1953); Phys. Rev. 92,1076(1953). *F.I.Boley, D.J. Zaffarano, Phys. Rev. 84,1059(1951).

K^{39} 19 20 stable

μ +0.39087 *1* KCO_2H I

E.Brun, J.Oeser, H.H.Staub, C.G.Telschow, Phys. Rev. 93, 172 (1954).

K^{40} 19 21 1.3×10^{9y}

$A^{40}/K^{40} = 0.0537 \pm 0.0014$ for one of feldspar samples for which Russell et al found 0.037 ± 0.004. Estimate feldspar age < Russell value, use same τ_{total}, conclude $\epsilon/\beta^- \sim 0.13$

G.J.Wasserburg, R.J.Hayden, Phys. Rev. 93,645 (1954); * R.D.Russell, H.A.Shillibeer, R.M.Farquhar, A.K.Mousuf, Phys. Rev. 91,1223 (1953).

K^{41} 19 22 stable

μ	-0.21453 3	KCO_2H	I
$\nu(K^{41})/\nu(K^{39}) = 0.54886$ 8			

E.Brun, J.Oeser, H.H.Staub, C.G.Telschow, Phys. Rev. 93, 172 (1954).

K^{42} 19 23 12.5^h

No $(2.04\ \beta)(1.51\ \gamma)$ polarization-direction

D.R.Hamilton, A.Lemonick, F.M.Pipkin, Phys. Rev. 92. 1191(1953); 90, 370A(1953)

K^{44} 19 25 22^m

τ	22.0^m	$Ca^{44}(\leq 20$-Mev n)	chem
β^-	1.5		scin
	4.9		
γ	1.13		scin
	2.07		
	2.48		
	3.6 ?		

Other unresolved γ's with $E_\gamma < 0.5$

B.L.Cohen, Phys. Rev. 94, 117 (1954).

Ca

$Ca(\alpha,\alpha'\gamma)$ $E_\alpha = 3.0$

No γ scin

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93, 351 (1954).

Ca^{47} 20 27 4.8^d

τ		5.4^d 1	Ca^{46}(pile n)	chem
β^-	60%	0.46		$s\pi\sqrt{2}$
	40%	1.40		
γ		0.1495		$s\pi$ ce^-_K
		0.234		ce^-_K
		0.495		ce^- pe^-
		0.80		pe^-
		1.30		pe^-

$(>0.6\beta)(\sim 0.2\gamma)$

J.M.Cork, J.M.LeBlanc, M.K.Brice, W.H.Nester, Phys. Rev. 92, 367 (1953).

τ		4.3^d 2	Cr(420-Mev p)	chem
β^-	81%	0.685		sl
	19%	2.060	F-K plot linear	

L.Marquez, Phys. Rev. 92, 1511 (1953).

β^-	~80%	0.8	Ca(26-Mev d)	chem; a
	~20%	2.0	Ti(26-Mev d)	chem
γ		1.3		scin

A.H.W.Aten, Jr., E.Greuell, W.J.van Dijk, Physica 19, 1049 (1953).

Sc^{40} 21 19 0.22^s

τ	0.22^s	Ca(15.9 ± 1.0-Mev p)
β^+	9.0	scin
γ	3.75	

No heavy particles. No other γ

N.W.Glass, J.R.Richardson, Phys. Rev. 93,942A (1954).

Sc^{43} 21 22 4.0^h

γ 25† 0.375 scin

†Percent of β^+

R.H.Nussbaum, R. van Lieshout, A.H.Wapstra, Phys. Rev. 92, 207 (1953).

Sc^{44} 21 23 4.0^h

$0.511\gamma/1.16\gamma = 1.96 \pm 0.15$ scin

Na^{22} comparison ($\epsilon = 10\%$)

$\beta^+/(\epsilon+\beta^+) = 0.98 \pm 0.08$

Theory gives $\beta^+/(\epsilon+\beta^+) = 0.96$

H.Langevin, N.Marty, J. Phys. radium 15, 127 (1954).

Sc^{45} 21 24 stable

$Sc^{45}(\alpha,\alpha'\gamma)$ $E_\alpha = 3.0$

No γ scin

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93, 351 (1954); priv. comm.

Sc^{46} 21 25 84^d

β^- 0.10% 1.25 $\log f_0t = 11.3$ sl

Shape fitted by C_{2T} ($\Delta I = 2$, no) not ($\Delta I = 3$, no)

G.L.Keister, F.H.Schmidt, Phys. Rev. 93,140 (1954); 91, 483A (1953).

γ	(0.88)	$\alpha = 1.3\times10^{-4}$	sl ce^-
	(1.11)	$\alpha = 2.6\times10^{-4}$	

E.F.Sturcken, Z.O'Friel, A.H.Weber, Phys. Rev. 93, 1053 (1954).

No delayed $\gamma\gamma$ ($\tau < 10^{-6s}$)

H.S.Murdoch, A.J.Webb, Proc. Phys. Soc. 67A, 286 (1954).

Sc^{47} 21 26 3.43^d

τ		3.44^d 5	d 4.8^dCa	
β^-	28%	0.280	F-K plot linear	sl
	72%	0.490	F-K plot linear	
γ		~0.22		sl ce^-

L.Marquez, Phys. Rev. 92, 1511 (1953).

τ	3.40^d 5	d 4.8^dCa	
β^-	0.64		$s\pi\sqrt{2}$
γ	0.1595	K/LM~10	$s\pi$ ce^-

$(0.64\beta)(0.16\gamma)$

J.M.Cork, J.M.LeBlanc, M.K.Brice, W.H.Nester, Phys. Rev. 92, 367 (1953).

Sc^{48}
21 27
1.83^d

γ 100† (0.98) Ti(≤ 18-Mev n) scin
100† 1.04 V^{48} comparison
100† (1.32)
$\gamma\gamma\gamma$
H.Casson, L.S.Goodman, V.E.Krohn, Phys. Rev. 92, 1517 (1953).

(1.04γ) (0.98γ) (θ) I = 6, 4, 2, 0

C.E.Whittle, P.S.Jastram, Phys. Rev. 92,205, (1953).

Sc^{49}
21 28
57^m

τ 57^m Ca(13-Mev d) chem
β^- 2.00 a
No γ (E_γ/β < 0.05 Mev) a

L.Koester, Z.Naturf. 9A, 104 (1954).

Ti

Ti($\alpha,\alpha'\gamma$) E_α = 3.0
γ 0.155 scin
0.433

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93,351 (1954).

Ti^{44}
22 22
2.7^y

τ 2.7^y Sc^{45}(30-Mev p) chem
γ 0.16 scin
D 4.0^hSc chem Not D 2.4^dSc

R.A.Sharp, R.M.Diamond, Phys. Rev. 93,358 (1954).

Ti^{45}
22 23
3.07^h

No 0.45γ (< 1.5% of β^+) scin, $\beta\gamma$

R.H.Nussbaum, R.van Lieshout, A.H.Wapstra, Phys. Rev. 92, 207(1953).

Ti^{47}
22 25
stable

I 5/2 $Ti^{47}Cl_4$ I
μ -0.7871* *1*
*From $\nu(Ti^{47})/\nu(D)$ = 0.36721 *6*
Also $\nu(Ti^{47})/\nu(Cl^{35})$ = 0.57493 *6*

C.D.Jeffries, Phys. Rev. 92,1262,1096A(1953).

Ti^{49}
22 27
stable

7/2 $Ti^{49}Cl_4$ I
μ -1.1023* *2*
*From $\nu(Ti^{49})/\nu(D)$ = 0.36731 *6*
Also $\nu(Ti^{49})/\nu(Cl^{35})$ = 0.57508 *6*

C.D.Jeffries, Phys. Rev. 92,1262,1096A(1953).

Capture γ's Ti(n,γ) sl pe⁻
0.346*
0.511 (annihilation γ's)*
1.385
1.500*
1.590*
1.785*
Mass assignment from intensity
Observed range E_γ 0.3 to 2.0

H.T.Motz, Phys. Rev. 93, 925A(1954); *verbal report.

Ti^{51}
22 29
5.8^m

No 0.48γ (< 3% of 0.325γ) scin

R.H.Nussbaum, R. van Lieshout, A.H.Wapstra, Phys. Rev. 92, 207 (1953).

V^{47}
23 24
31.1^m

τ 31.1^m Ti(13-Mev d) chem
β^+ 1.90 a
No γ (E_γ/β < 0.06 Mev) a

L.Koester, Z.Naturf. 9A, 104(1954).

No γ (< 20%) Ti(26-Mev d) chem; a

A.H.W.Aten, Jr., J.Kooi, B. de Vries, A.L. Veenendaal, Physica 19, 1051 (1953).

V^{48}
23 25
16.0^d

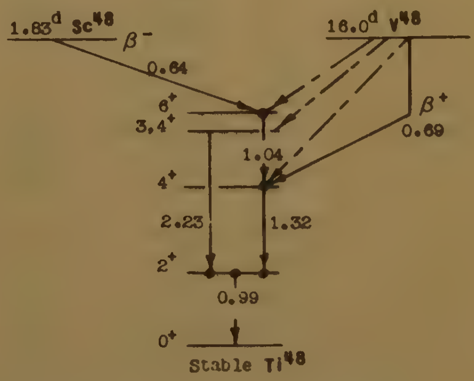
β^+ 0.692 Cr(420-Mev p) chem
No 0.82β^+ (< 0.2%) sl
No > 0.87β^+ (< 0.1%)

L.Marquez, Phys. Rev. 92, 1511 (1953).

$\gamma\gamma(\theta)$ I = 4, 2, 0

D.G.Alkhazov, I.Kh. Lemberg, A.P.Grinberg, Izvest. Akad. Nauk Ser. Fiz. SSSR 17, 487 (1953).

(2.2γ) (0.99γ) Cr(22-Mev d) chem scin
$\gamma\gamma\gamma$ in 10 ± 5 % of disintegrations
β^+/(1.32γ) = 0.49 ± 0.04 assuming Na^{22} β^+/ϵ = 19



H.Casson, L.S.Goodman, V.E.Krohn, Phys. Rev. 92, 1517 (1953).

V^{50}
23 27
$>10^{12y}$

I 6 para
$\mu(V^{50})/\mu(V^{51})$ = 0.6501 *14*

C.Kikuchi, M.H.Sirvetz, V.W.Cohen, Phys. Rev. 92, 109(1953); Phys. Rev. 88, 142 (1952).

V^{51}
23 28
stable

Q ~0.3 S

K.Murakawa, T.Kamei, Phys. Rev. 92,325(1953).

V^{51} 23 28 stable

$V(\alpha,\alpha'\gamma)$ $E_{\alpha} = 3.0$

γ 0.320 scin

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93,351 (1954).

V^{52} 23 29 3.77^{m}

τ 3.77^{m} Cr(fast n) chem

No low energy ce^{-} sl

No 2.6^{m} activity

G.Weber, Z.Naturf. 9A, 115 (1954).

τ 3.75^{m} V(pile n)

β^{-} ~2.6 $a\beta\gamma$

γ 1.44

No ce^{-}

$(2.6\beta)(1.44\gamma)$

No 2.6^{m} nor 16^{h} activity found for V^{52}

J.M.LeBlanc, J.M.Cork, S.B.Burson, W.C.Jordan, Phys. Rev. 93, 1124 (1954).

τ 3.77^{m} V(13-Mev d)

β^{-} 2.47 a

E_{γ}/β = 1.5 Mev a

L.Koester, Z.Naturf. 9A, 104 (1954).

Levels V(d,p) $E_{d} = 5.74$ sr

93†	g.s.		
36†	0.13	48†	2.13
7†	0.42	33†	2.15
50†	0.78	40†	2.31
75†	0.83	39†	2.42
21†	1.40	10†	2.46
13†	1.48	22†	2.53
100†	1.55	21†	2.85
50†	1.75	20†	3.00
38†	1.79	41†	3.05
20†	1.84	52†	3.19
43†	2.09	29†	3.31

J.E.Schwager, L.A.Cox, Phys. Rev. 92,102(1953).

V^{53} 23 30 23^{h}

τ 23^{h} Cr^{53}(pile n) chem

β^{-} 0.6 a

γ's scin

R.K.Sheline, J.R.Wilkinson, Phys. Rev. 94, 729 (1954).

Cr

$Cr(\alpha,\alpha'\gamma)$ $E_{\alpha} = 3.0$

No γ scin

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93,351 (1954).

Cr

Resonance Cr(n) E_{n} = 3 to 10^{5} ev

3800 ev $\sigma_{0}\Gamma^{2} = 8.55 \times 10^{7}$

time of flight

E.Melkonian, W.W.Havens, Jr., L.J.Rainwater, Phys. Rev. 92, 702 (1953).

Cr^{49} 24 25 41.8

Ti(45-Mev α) chem

β^{+} 1.47 a

γ 15† 0.063 $\alpha = 0.14$ M1 sl ce,

30† 0.091 $\alpha = 0.06$ M1 scin

14† 0.150 $\alpha = 0.16$ E2

No 0.73 β^{+} No 0.61 γ (<4†) No 1.57 γ

R.H.Nussbaum, A.H.Wapstra, G.J.Nijgh, L.Th.Ornstein, N.F.Verster, Physica 20, 165 (1954); Phys. Rev. 92, 207(1953).

Cr^{51} 24 27 27^{d}

No 0.48γ (<3% of 0.325γ) scin

R.H.Nussbaum, R. van Lieshout, A.H.Wapstra, Phys. Rev. 92, 207 (1953).

Cr^{52} 24 28 stable

Level Cr(n,n'γ) $E_{n} = 2.5$

γ 1.42 scin

Assignment from agreement with 6.0^{d} Mn^{52} γ

E.A.Eliot, D.Hicks, L.E.Beghian, H.Halban, Phys. Rev. 94, 144 (1954).

Level Cr(n,n'γ) $E_{n} = 3.9$

γ 1.43 scin

Assignment from agreement with $6.0^{d}$$Mn^{52}$ γ

M.A.Rothman, C.E.Mandeville, Phys. Rev. 93, 796(1954); 92, 1097A (1953).

Mn^{51} 25 26 45^{m}

τ 45.2^{m} Cr(13-Mev d) chem

β^{+} 2.16 a

No γ (E_{γ}/β < 0.1 Mev) a

L.Koester, Z.Naturf. 9A, 104 (1954).

No γ (<20%) Cr(8-Mev d) chem; a

A.H.W.Aten, Jr., J.Kool, B. de Vries, A. L. Veenendaal, Physica 19, 1051 (1953).

Mn^{54} 25 29 320^{d}

τ_{a} 324^{d} Fe^{54}(pile n) chem

γ 0.83

G.H.Stafford, L.H.Stein, Nature 172,1103(1953)

Mn^{55} 25 30 stable

Q ~0.4 S

K.Murakawa, T.Kamei, Phys. Rev. 92,325(1953).

$Mn^{55}(\alpha,\alpha'\gamma)$ $E_{\alpha} = 3.0$

γ 0.128 scin

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93,351 (1954).

Mn^{56} 25 31 2.58^{h}

γ (1.8) M1 98% E2 2% $\gamma\gamma(\theta)$

(2.1) M1 92% E2 8%

(1.8γ) (0.85γ) (θ) I = 2, 2, 0

(2.1γ) (0.85γ) (θ) I = 2, 2, 0

F.R.Metzger, W.B.Todd, Phys. Rev. 92,904(1953)

Mn^{56} 25 31 2.58^h

$(0.845\gamma)(1.81\gamma, 2.13\gamma)$
No $(1.81\gamma)(2.13\gamma)$

E.Germagnoli, A.Malvicini, L.Zappa, Nuovo Cim. 10, 1388 (1953).

Fe

	Fe $(\alpha,\alpha'\gamma)$	$E_\alpha = 3.0$	
γ	0.122		scin

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93,351 (1954).

γ	Fe $(n,n'\gamma)$	$E_n = 14$	scin
	0.85	1.44	$n'\gamma$
	1.29	2.10	Cf Fe^{56}

R.E.Garrett, F.L.Hereford, B.W.Sloope, Phys. Rev. 92, 1507 (1953); 91, 441A (1953).

Fe^{53} 26 27 9^m

γ 30† 0.370 scin
†Percent of β^+

R.M.Nussbaum, R. van Lieshout, A.H.Wapstra, Phys. Rev. 92, 207 (1953).

Fe^{55} 26 29 2.9^y

E_{dis} 0.23 scin
From continuous γ endpoint

L.Madansky, F.Rasetti, Phys. Rev. 94,407(1954).

S.E.Singer, W.S.Emmerich, J.D.Kurbatov, Phys. Rev. 94, 113, 779A (1954).

Fe^{56} 26 30 stable

Level	Fe $(n,n'\gamma)$	$E_n = 2.5$	
γ	0.9		scin

Assignment from agreement with 2.58^h Mn^{56} γ

E.A.Eliot, D.Hicks, L.E.Beghian, H.Halban, Phys. Rev. 94, 144 (1954).

	Fe $(n,n'\gamma)$	$E_n = 3.9$	
γ	0.85		scin
	1.80		
	2.15		

Assignment from agreement with 2.58^h Mn^{56} γ's

M.A.Rothman, C.E.Mandeville, Phys. Rev. 93, 796 (1954); 92, 1097A (1953).

Fe^{59} 26 33 45^d

τ 46.0^d 2 Fe(pile n) chem
Counted for 16 days differential ic

J.Tobailem, J. phys. radium 14, 553 (1953).

Co^{55} 27 28 18^h

			Fe (11.5-Mev d)	chem
β^+	2.3†	0.26		sl
	4.9†	0.53		
	39.5†	1.03		
	53.3†	1.500		
			ce^-/β^+ (x10^5)	
γ	2†	0.253		scin
	28†	0.477	11.0	sl ce^-
	150†	0.935	12.4	
	20†	1.41	3.5	
	0.6†	1.84		scin
	4†	2.17		

R.S.Caird, A.C.G.Mitchell, Phys. Rev. 94,412 (1954).

Co^{56} 27 29 80^d

β^+	4%*	0.44		sl
	96%*	1.50	Fe^{56} (20-Mev p)	chem
γ	100†*	0.835		scin
	55†*	1.23		
	24†*	1.74		
	12†*	2.31		
	14†*	2.60		
	24†*	3.25		

$(0.511\gamma)(0.835\gamma, 1.23\gamma)$ *

M.Sakai, J.Dick, J.D.Kurbatov, Phys. Rev. 94, 779A(1954); * verbal report.

Co^{57} 27 30 270^d

			α_K	K/LM	
γ	15†	0.123	0.14	~8	(E)2
	1†	0.138	0.011	~8	(M)1
			Fe (d)	chem	$s\pi\sqrt{2}$

D.E.Alburger, M.A.Grace, Proc. Phys. Soc. 67A, 280 (1954).

Co^{59} 27 32 stable

Q 0.5 8

K.Murakawa, T.Kamei, Phys. Rev. 92,325(1953).

	Co^{59} $(\alpha,\alpha'\gamma)$	$E_\alpha = 3.0$	
No γ			scin

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93,351 (1954).

Co^{60} 27 33 5.2^y

$|\mu|$ 3.5 $\gamma(\theta,T)$

B.Bleaney, J.M.Daniels, M.A.Grace, H.Halban, N.Kurti, F.N.H.Robinson, F.E.Simon, Proc. Roy. Soc. 221A, 170 (1954).

β^- 0.15% 1.48 $\log f_0t = 12.6$ sl
Shape fitted by C_{2T} ($\Delta I = 2$, no) not ($\Delta I = 3$, no)

G.L.Keister, F.H.Schmidt, Phys. Rev. 93,140 (1954).

γ	(1.17)	$\tau \sim 10^{-11s}$
	(1.33)	$\tau \sim 10^{-11s}$

Z.Bay, V.P.Henri, F.McLernon, Phys. Rev. 94, 780A(1954); verbal report.

γ (1.33) $\tau < 7 \times 10^{-10s}$ $\gamma\gamma$

S.Gorodetzky, A.Knipper, R.Armbruster, A. Gallmann, J. phys. radium 14, 550 (1953).

Resonance Co^{59} (n) chopper
134 ev J = 3 $\Gamma = 5.5$ ev

F.G.P.Seidl, Phys. Rev. 93, 931A (1954).

Ni

	Ni $(\alpha,\alpha'\gamma)$	$E_\alpha = 3.0$	
No γ			scin

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93,351 (1954).

Ni^{59} 28 31 7.5×10^{5y}

E_{dis} 1.07 scin
From continuous γ endpoint
No 0.511 γ ($< 4 \times 10^{-3}$%)

S.E.Singer, W.S.Emmerich, J.D.Kurbatov, Phys. Rev. 94, 113, 779A (1954).

Ni^{60} 28 32 stable

Ni(n,n'γ) $E_n = 3.9$
γ 0.907 scin
1.36
Assignment from agreement with Cu^{60} γ's q.v.

M.A.Rothman, C.E.Mandeville, Phys. Rev. 93, 796 (1954).

Ni^{63} 28 35 85^y

β^- 0.062 $\Delta I = 2$, yes shape EA

Y.Kobayashi, G.Miyamoto, S.Mori, J. Phys. Soc. Japan 8, 684 (1953).

Cu

Cu(α,α'γ) $E_\alpha = 3.0$
No γ scin

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93,351 (1954).

Level Cu(n,n'γ) $E_n = 3.8$
γ ~0.9 scin

M.A.Rothman, H.S.Hans, C.E.Mandeville, Phys. Rev. 94, 791A (1954).

γ Cu(n,n'γ) $E_n = 14$ scin
0.9 ? 1.53 n'γ
1.13 2.19

R.E.Garrett, F.L.Hereford, B.W.Sloope, Phys. Rev. 92, 1507 (1953); 91,441A (1953).

Cu^{60} 29 31 23^m

τ 23.4^m Ni(20-Mev d)
β^+ 73† 2.01 sl
19† 2.96
7† 3.84
γ 15† 0.81 scin
100† 1.33
80† 1.8
$E_{dis} = 6.19$
No 1.17γ (<10†)

R.Van Lieshout, R.H.Nussbaum, G.J.Nijgh, A.H.Wapstra, Phys. Rev. 93, 255 (1954).

Cu^{63} 29 34 stable

Q -0.13 S

H.Kopfermann, A.Steudel, S.Wagner, W.Walcher, Nachr. Akad. Wiss. Göttingen, Math-physik. Kl. IIa, No. 1 (1953).

Cu^{64} 29 35 12.8^h

γ 1.35 s pe$^-$
$\gamma/\beta^+ = 0.042$

B.S.Dzhelepov, N.N.Zhuckovskii, V.P.Prikhodtseva, Yu. V.Khol'nov, Izvest. Akad. Nauk Ser. Fiz. SSSR 17, 511 (1953); Chem. Abstr. 48-2488d (1954).

Cu^{66} 29 37 5.10^m

τ 5.20^m Cu(13-Mev d)
β^- 90% 2.60 a
$E_\gamma/\beta = 0.10$ Mev a

L.Koester, Z.Naturf. 9A, 104 (1954).

Zn^{65} 30 35 245^d

τ 245.0^d s Zn(pile n) chem
Counted for 60 days differential ic

J.Tobailem, J. phys. radium 14, 553(1953).

β^+ 1.7% 0.325 FK plot linear to 0.05
γ 44.1% (1.11) $\alpha = 2.6 \times 10^{-4}$ E2 sl
K/LM <10
ϵ_{gs} 54.2%
e_A^- : β^+ : ce$^-$ = 10,300 : 361 : 2.35

J.F.Perkins, S.K.Haynes, Phys. Rev. 92, 687, 1096A(1953).

β^+ 0.327 Cu(d,2n) chem; sl
γ (1.11) $\alpha = 1.8 \times 10^{-4}$
No 0.20γ ($< 3 \times 10^{-4}$)
$\gamma/\beta^+ = 28 \pm 7$
$\epsilon_{gs}/\beta^+ = 34 \pm 7$(calc) thus $\Delta L = 0$ transition

R.Bouchez, P.Hubert, N.Perrin, M.Sakai, J. phys. radium 14, 29A; 14,273(1953); Compt. rend. 236, 1249 (1953).

β^+ 0.325 s
γ 1.122 $\alpha = 1.7 \times 10^{-4}$ s ce$^-$
$\gamma/\beta^+ = 33 \pm 3$ s pe$^-$

A.A.Bashilov, N.M.Anton'eva, D.C.Broder, B.S.Dzhelepov, Izvest. Akad. Nauk Ser. Fiz. SSSR 17, 468 (1953); Chem. Abstr. 48-2488h (1954).

β^+ 0.320 ST
$\gamma/\beta^+ = 24 \pm 1$ Na^{22}comparison(ϵ = 10%) scin

T.Yuasa, Compt. rend. 237, 1077 (1953).

$\gamma/\beta^+ = 31 \pm 5$ scin

D.Maeder, R.Müller, V.Wintersteiger, Helv. Phys. Acta 27, 3 (1954).

γ (1.11) $\alpha = 2.2 \times 10^{-4}$ sl Cpt

E.F.Stuercken, Z.O'Friel, A.H.Weber, Phys. Rev. 93, 1053 (1954).

Level Cu(p,n) $E_p = 2$ to 4
[redacted]
"Threshold" neutrons detected

C.F.Cook, T.W.Bonner, Phys. Rev. 94,807A(1954).

Zn^{67} 30 37 stable

γ Zn($\alpha,\alpha'\gamma$) $E_\alpha = 3.0$
0.093 scin
0.182

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93,351 (1954).

Zn^{69} 30 39 14^h

γ 0.439 $\alpha_K = 0.040$ M4 s
K/LM = 7.5

V.N.Dolishnyuk, G.M.Drabkin, V.I.Orlov, L.I.Rusinov, Doklady Akad. Nauk SSSR 92, 1141 (1953); NSF-tr-229

Zn^{69} 30 39 52^m

β^- 0.92 d 14^hZn s

V.N.Dolishnyuk, G.M.Drabkin, V.I.Orlov, L.I.Rusinov, Doklady Akad. Nauk SSSR 92, 1141 (1953); NSF-tr-229.

Levels Zn^{68}(d,p)
g.s. $l_n = 1$ d,p(θ)
(0.439) $l_n = 4$

F.S.Eby, R.D.Hill, W.K.Jenschke, Phys. Rev. 93, 925A (1954).

Ga Relative abundances

A	69	71
%	60.5	39.5

S.Antkiw, V.H.Dibeler, J. Chem. Phys. 21, 1890 (1953).

Ga($\alpha,\alpha'\gamma$) $E_\alpha = 3.0$
No γ scin

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93,351 (1954).

Resonances Ga(n) $E_n = 0.8$ to 10^5 ev time of flight

E_0 (ev)	$\sigma_0\Gamma^2$
102	2,200
310	170,000
500?	
1000?	

E.Melkonian, W.W.Havens, Jr., L.J.Rainwater, Phys. Rev. 92, 702(1953).

Ga^{65} 31 34 15^m

τ_1 15^m Cu(α) chem
γ IT? 0.052 α large sl ce$^-$, scin
0.092
0.114

B.Crasemann, Phys. Rev. 93, 1034 (1954).

τ_1 15^m Zn(18-Mev d) chem
β^+ 2.1 a
No γ ($E_\gamma/\beta < 0.3$ Mev) a
[β^+ in 8^m Ga^{65} ?]

L.Koester, Z.Naturf. 9A, 104 (1954).

Ga^{65} 31 34 8^m

τ_2 8.0^m Cu(α), Zn(d) chem
not Zn(p)
β^+ s
No γ sl ce$^-$ pe$^-$, scin

B.Crasemann, Phys. Rev. 93, 1034 (1954).

Ga^{66} 31 35 9.4^h

γ scin

2†	0.83	22†	2.75
30†	1.04	2†	3.24
3†	1.37	3†	3.41
	1.58 ?	2†	3.78
4†	1.93	2†	4.12
6†	2.18	5†	4.33
2†	2.40	2†	4.83

($<0.5\beta$) (1.04, 1.37, 2.18, 2.75, 3.24, 3.41 γ's)
($<0.5\beta$) (2.40, 3.78γ's)?
($>1.0\beta$) (1.04, 1.37, 2.40?, 2.75 γ's)
($>2.2\gamma$) (1.04, 1.58 γ's)
†Photons per 100 disintegrations assuming 40% ϵ

L.G.Mann, W.E.Meyerhoff, H.I.West, Jr., Phys. Rev. 92, 1481 (1953).

Ga^{67} 31 36 78^h

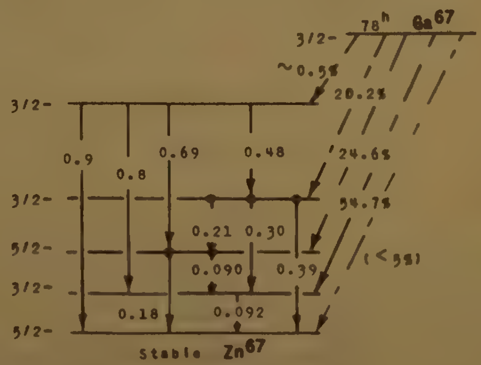
γ scin
100† {(0.090) (0.092)}
55† {(0.182) (0.21)}
39† (0.30)
5† (0.39)

D.Maeder, R.Müller, V.Wintersteiger, Helv. Phys. Acta 27, 3 (1954).

No β^+ (< 0.01%)

γ 7†	0.090			scin
93†	0.092	$\alpha = 0.54$	$\tau = 9.5^{\mu s}$	
44†	0.182	~0.2†	0.48	
3†	0.21	~0.1†	0.69	
28†	0.30	~0.2†	~0.8	
10†	0.39	~0.6†	~0.9	

(0.69γ) (0.18γ) (0.21γ) (0.18γ)
(0.48γ) (0.39γ, 0.30γ, 0.18γ, 0.21γ)
0.09γ, 0.21γ, 0.30γ preceed 0.092γ
No γ follows 0.092γ
(0.21γ) (0.18γ) (θ) I = 3/2, 5/2, 5/2



W.E.Meyerhof, L.G.Mann, H.I.West, Jr., Phys. Rev. 92, 758 (1953).

Ga^{68} 31 37 68^m

τ 68^m Zn(13-Mev d) chem
β^+ 1.90 a
No γ ($E_\gamma/\beta < 0.1$ Mev) a

L.Koester, Z.Naturf. 9A, 104 (1954).

Ga^{69} 31 38 stable

$Q(Ga^{69})/Q(Ga^{71})$ = 1.5867 4 $GaCl_3$ quad res

H.G.Dehmelt, Phys. Rev. 92, 1240 (1953).

Ge^{67} 32 35 20^m

τ 19^m Zn(52-Mev α) chem
β^+ 3.4 a
γ 0.17 scin

A.H.W.Aten, Jr., T. de Vries-Hamerling, L. Lindner, Physica 19, 1046 (1953).

Ge^{73} 32 41 stable

μ -0.8768 1 $GeCl_4$ I
$\nu(Ge^{73})/\nu(D)$ = 0.22725 3

C.D.Jeffries, Phys. Rev. 92,1262(1953).

Ge($\alpha,\alpha'\gamma$) E_α = 3.0
γ 0.068 scin

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93,351 (1954).

Ge^{75} 32 43 82^m

γ	~2.2†*	(0.067)	<0.03†*	(0.405)	scin
	<0.15†*	(0.138)	2.5†	0.427*	
	12†*	(0.203)	2.3†	0.48 *	
	100†	(0.269)	1.8†	0.628*	

(0.427γ,0.067γ)(0.203γ)* No other $\gamma\gamma$
(~0.88β)(0.269γ)

A.W.Schardt, J.P.Welker, Phys. Rev. 93, 916A (1954); *verbal report.

As^{73} 33 40 76^d

γ (0.0135) $\alpha \geq 1300$ $\tau = 4.6^{\mu s}$
(0.0539) $\alpha = 4.7$ $\tau = 0.33^{s*}$
0.0135γ follows 0.054γ scin
No 0.081γ (< 0.2% of 0.054γ) No 0.0674γ
All ϵ to 0.0674 level

J.P.Welker, A.W.Schardt, G.Friedlander, J.J. Howland, Jr., Phys. Rev. 92,401(1953); 91, 484A(1953). *E.C.Campbell, ibid.

γ (0.054) α~8 scin, pc

R.Barloutaud, R.Ballini, M.Sartori, Compt. rend. 237, 886 (1953).

As^{75} 33 42 stable

$As^{75}(\alpha,\alpha'\gamma)$ E_α = 3.0
γ 0.068 scin
0.199
0.281

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93,351 (1954).

As^{76} 33 43 26.5^h

τ		26.4^h	As(pile n) chem	
β^-	3%	0.35		sl
	6%	1.20		
	6%	1.75		
	32%	2.40		
	53%	2.96	$\Delta I = 2$, yes shape	
γ	100†	0.555		sl pe$^-$
	9†	0.648		
	23†	1.210		
	1.5†	1.410		
	5†	2.06		

P. Hubert, Ann. Phys. 8, 662 (1953).

β^+ 0.67 B
$\beta^+/\beta^- \sim 10^{-3}$ cc

S.B.Murray, J.D.Kurbatov, Phys. Rev. 94, 780A (1954).

γ (0.55) E2
(2.41β)(0.55γ) polarization-direction

D.R.Hamilton, A.Lemonick, F.M.Pipkin, Phys. Rev. 92, 1191 (1953); 90, 370A(1953).

Capture γ's $As^{75}(n,\gamma)$ s pr

2†	4.53	1†	6.05
1†	4.77	2†	6.38
1†	4.97	2†	6.85
2†	5.17	2†	7.05
1†	5.41	0.5†	7.30

Also graph E_γ = 2.5 to 8
†Photons per 100 n captures

G.A.Bartholomew, B.B.Kinsey, Can. J. Phys. 31, 1025(1953).

Se

Capture γ's Se(n,γ) s pr

2.0†	4.57	2.3†	6.02
0.7†	5.21	1.2†	6.23
2.1†	5.59	0.9†	6.41
1.4†	5.80		

Also graph E_γ = 3.5 to 10.6
See also Se^{77} and Se^{78}
†Photons per 100 n captures

B.B.Kinsey, G.A.Bartholomew, Can. J. Phys. 31, 1051(1953).

Se^{73}? 34 39 44^m

τ 44^m Ge(52-Mev α) chem
β^+ 1.7 a
Not p 52^mAs (< 0.1%)
$\sigma(7^h Se)/\sigma(44^m Se) \sim 5$ E_α = 33 to 52

F.N.Hooge, A.H.W.Aten, Jr., Physica 19,1047 (1953).

Se^{75} 34 41 127^d

I 5/2 $OCSe^{75}$ M
Q +0.9

L.C.Aamodt, P.C.Fletcher, G.Silvey, C.H.Townes, Phys. Rev. 94, 789A (1954).

Se^{75} 34 41 127^d

γ ~1† (0.067) ~0.2† (0.203) scin
~4† (0.098) 100† {(0.269) (0.281)}
84† {(0.124) (0.138)} 17† (0.405)
(0.067γ)(0.138γ,0.203γ) (0.124γ)(0.281γ)
(0.138γ)(0.269γ) No (0.405γ)(γ)

A.W.Schardt, J.P.Welker, Phys. Rev. 93, 916A, 910 (1954).

Se^{77} 34 43 stable

I 1/2 $(Se^{77})_2$ B

S.P.Davis, Phys. Rev. 93, 159 (1954).

$Se^{77}(\alpha,\alpha'\gamma)$ $E_\alpha = 3.0$
γ 0.237 scin

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93,351 (1954); priv. comm.

Capture γ's Se(n,γ) s pr
3.6† 6.586
0.3† 6.88 ?
1.8† 7.185
2.2† 7.416
Above γ's fit Se^{77} levels known from Br^{77} decay. See also Se
†Photons per 100 n captures in Se

B.B.Kinsey, G.A.Bartholomew, Can. J. Phys. 31, 1051(1953).

Se^{78} 34 44 stable

I 0 $(Se^{78})_2$ B

S.P.Davis, Phys. Rev. 93, 159 (1954).

Capture γ's Se(n,γ) s pr
0.7† 7.73 0.7† 9.172
0.1† 7.95 1.0† 9.882
0.5† 8.092 0.08† 10.483
0.2† 8.50
>7.3 γ's assigned to Se^{78} from intensities and known mass ratio
†Photons per 100 n captures in Se

B.B.Kinsey, G.A.Bartholomew, Can. J. Phys. 31, 1051(1953).

Se^{79} 34 45 6.5×10^{4y}

I 7/2 Mic
μ -1.015
Q 0.7

W.A.Hardy, G.Silvey, C.H.Townes, B.F.Burke, M.W.P.Strandberg, G.W.Parker, V.W.Cohen, Phys. Rev. 92, 1532(1953); 85,494 (1952).

Se^{80} 34 46 stable

I 0 $(Se^{80})_2$ B

S.P.Davis, Phys. Rev. 93, 159 (1954).

Br

Br(α,α'γ) $E_\alpha = 3.0$
γ 0.044 scin
0.213
0.266

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 93,906 (1954).

Br^{74} 35 39 36^m

τ 36^m Cu^{65}(90-Mev C) chem
Mass assignment based on yields in Cu^{65}(C,xn) and Cu^{63}(C,xn) reactions not p 7.1^hSe^{73}

J.M.Hollander, Phys. Rev. 92, 518 (1953).

Br^{80} 35 45 18.5^m

β^- ~15†* (1.42) Br(slow n)chem; sl
85†* 2.04*
β^+ 4† 0.862
γ 12† 0.62 scin

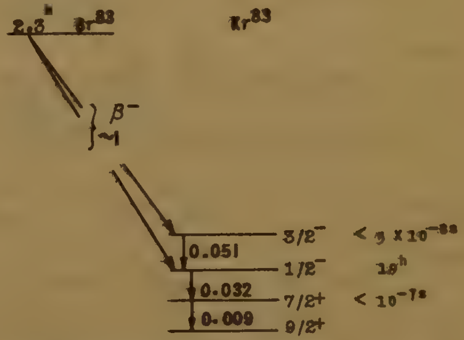
L.Lidofsky, R.Gold, C.S.Wu, Phys. Rev. 94,780A (1954); * verbal report.

γ 0.62 Br^{79}(pile n) scin

J.Laberrigue-Frolow, M.Langevin, R.Bernas, Compt. rend. 238, 677 (1954).

Br^{83} 35 48 2.3^h

τ 2.30^h .5 Se(10-Mev d) chem
γ 0.051 K/L> 8 M1 $s\beta e^-$
$\tau < 5\times10^{-8s}$ $\beta\gamma$
$e^-/\beta = 0.12$ cc



P.Swinbank, J.Walker, Proc. Phys. Soc. 66A, 1093(1953).

Kr^{76} 36 40 9.7^h

τ 9.7^h Y^{89}(150-Mev p) chem
No β^+ with $E_{\beta+} > 0.6$ p 17^hBr s
No x ray pc

A.A.Caretto, Jr., E.O.Wiig, Phys. Rev. 93,175 (1954).

Kr^{79} 36 43 34.5^h

γ (0.044) $\tau < 3^{\mu s}$ e_Ace^- pc
$(ce^-\ 0.044\gamma)/(e_A(K)) \sim 0.007$
$e_A(L)/e_A(K) = 1.66$
$\epsilon_L/\epsilon_K = 0.10$ or 0.25 (0.10* theory) for fluorescence yield 0.63 or 0.57** resp.

M.Langevin, P.Radvanyi, Compt. rend. 238,77, 232(1954); *Broyles, Thomas, Haynes, Phys. Rev. 89,723(1953); **Burhop, The Auger Effect, Camb. Univ. Press p. 48(1952).

Kr^{85} 36 49 10.3^y

Levels $Kr^{84}(d,p)$ $E_d = 3.80$ a

0.29 2.21*

1.60* 2.94*

*Or 1.18, 1.79, 2.52 levels in Kr^{87}

G.W.Wheeler, R.B.Schwartz, W.W.Watson, Phys. Rev. 92, 121 (1953).

Kr^{87} 36 51 78^m

Levels $Kr^{86}(d,p)$ $E_d = 3.80$ a

[illegible]

1.17*

2.01*

*Or 1.59, 2.43 Kr^{85} levels in Kr^{85}

G.W.Wheeler, R.B.Schwartz, W.W.Watson, Phys. Rev. 92, 121 (1953).

Rb

$Rb(\alpha,\alpha'\gamma)$ $E_\alpha = 3.0$

γ 0.150 scin

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93, 351 (1954).

Rb^{82} 37 45 1.25^m

τ_{1} 1.25^m d 26^dSr chem

β^+ (3.15) a

No γ with $E_\gamma > 0.6$

Not p 6.3^hRb (< 0.1%)

L.M.Litz, S.A.Ring, W.R.Balkwell, Phys. Rev. 92, 288 (1953).

Rb^{86} 37 49 19.5^d

γ (1.08) E2

$(0.72\beta)(1.08\gamma)$ polarization-direction

D.R.Hamilton, A.Lemonick, F.M.Pipkin, Phys. Rev. 92, 1191 (1953); 90, 370A (1953).

Rb^{87} 37 50 $6.2 \times 10^{10}y$

τ $6.2 \times 10^{10}y$ 89.62% Rb^{87}

β^- 0.275 sl

Shape fitted by C_{3T} with $\rho = 2.37$

$\rho = Q_3(\beta a, r)/Q_3(\beta\sigma \times r, r)$

M.H.MacGregor, M.L.Wiedenbeck, Phys. Rev. 94, 138 (1954).

Sr

$Sr(\alpha,\alpha'\gamma)$ $E_\alpha = 3.0$ scin

No γ

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93, 351 (1954); priv. comm.

Capture γ's $Sr(n,\gamma)$ s pr

2†	5.43	5 †	6.95
2†	5.82	5 †	7.53*
4†	6.10	1.1 †	8.05*
5†	6.27	1.3 †	8.38*
6†	6.67	0.1 †	9.06*
6†	6.87	0.06†	9.22*

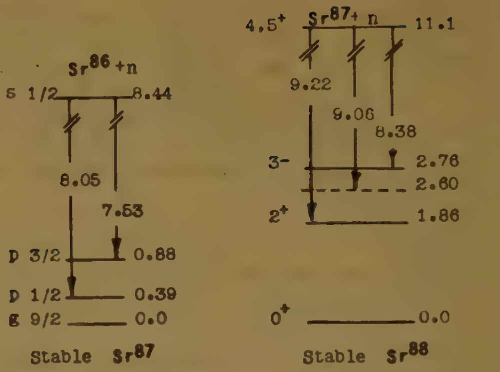
Also graph $E_\gamma = 2.5$ to 9.5

$B_n(Sr^{86\dagger}) = 8.5$; $B_n(Sr^{87\dagger}) = 11.2$ from γ,n

*See decay scheme for probable assignments

†Photons per 100 n captures

Sr



B.B.Kinsey, G.A.Bartholomew, Can. J. Phys. 31, 1051 (1953).

Sr^{82} 38 44 26^d

τ 27^d Zr (190-Mev d) chem

Parent 1.25^mRb; not p 6.3^hRb (<0.1%)

L.M.Litz, S.A.Ring, W.R.Balkwell, Phys. Rev. 92, 288 (1953).

Y^{89} 39 50 stable

μ -0.136824 $Y(NO_3)_3$ I

$\nu(Y^{89})/\nu(H) = 0.048994$ I

E.Brun, J.Oeser, H.H.Staub, C.G.Telschow, Phys. Rev. 93, 172 (1954).

$Y^{89}(\alpha,\alpha'\gamma)$ $E_\alpha = 3.0$

No γ scin

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 93, 906 (1954).

Y^{90} 39 51 64.6^h

τ 64.6^h 4 U(n,f) chem

Two samples, each counted for 28 days

A.Chetham-Strode Jr., E.M.Kinderman, Phys. Rev. 93, 1029 (1954).

Zr

$Zr(\alpha,\alpha'\gamma)$ $E_\alpha = 3.0$

No γ scin

Only 0.093 γ of Hf impurity observed

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93, 351 (1954).

Capture γ's $Zr(n,\gamma)$ s pr

16†	6.30
0.5†	7.38
1†	7.71
1†	8.66

Also graph $E_\gamma = 3$ to 9

$B_n(Zr^{90\dagger}) = 7.2$; $B_n(Zr^{91\dagger}) = 8.7$;

$B_n(Zr^{92\dagger}) = 6.6$; from Zr(d,p)

†Photons per 100 n captures

B.B.Kinsey, G.A.Bartholomew, Can. J. Phys. 31, 1051 (1953).

Zr^{88} 40 48 85^d

τ 85^d Nb(100-Mev p) chem
Counted growth and decay of 105^d Y^{88} 1.85γ
0.26 to 2.9 years after bombardment

E.K.Hyde, Phys. Rev. 92, 927 (1953).

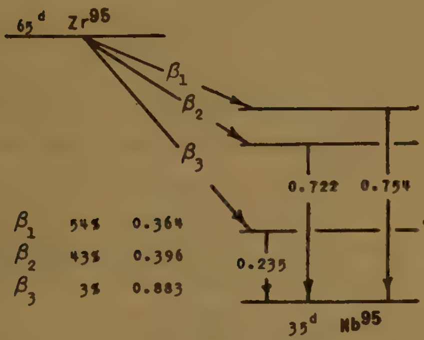
Zr^{91} 40 51 stable

μ -1.3 S

S.Suwa, J. Phys. Soc. Japan 8, 734(1953).

Zr^{95} 40 55 65^d

β^- 54% 0.364 $s\pi\sqrt{2}$
43% 0.396
3% (0.883)
γ 0.722 $\alpha_K = 0.0014$ $s\pi\sqrt{2}$ ce$^-$
0.754 $\alpha_K = 0.0011$
No $\beta\gamma(\theta)$



P.S.Mittelman, Phys. Rev. 94,99(1954); 91, 484A (1953).

$Nb^{92?}$ 41 51 13^h

τ 13^h Nb^{93}(14-Mev p) chem
γ 2.35 scin
x K x ray a
No β^+ scin
Not p 10^d Nb
$\sigma(10^d$ Nb$)/\sigma(13^h$ Nb$)\sim 10$ for $E_p = 14$ to 20

R.A.James, Phys. Rev. 93, 288 (1954).

Nb^{93} 41 52 stable

$Nb^{93}(\alpha,\alpha'\gamma)$ $E_\alpha = 3.0$
No γ scin

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93,351 (1954).

Nb^{94} 41 53 2.7×10^{4y}

Capture γ's $Nb^{93}(n,\gamma)$ s pr
0.8† 5.90
0.8† 6.85
0.4† 7.19
Also graph $E_\gamma = 2.5$ to 7.7
$B_n(Nb^{93})$= 7.3 from Nb^{93}(d,p)
†Photons per 100 n captures

G.A.Bartholomew, B.B.Kinsey, Can. J. Phys. 31, 1025(1953).

Nb^{95} 41 54 90^h

γ 0.220 K/LM = 4.3 s ce$^-$

V.M.Dobrishmyuk, G.M.Drabkin, V.I.Orlov, L.I.Rusinov, Doklady Akad. Nauk SSSR 92, 1141 (1953); NSF-tr-229

Nb^{95} 41 54 35^d

γ (0.77) K/LM = 2.4 sl ce$^-$
$\alpha = 0.0021$

E.F.Sturcken, Z.O'Friel, A.H.Weber, Phys. Rev. 93, 1053 (1954).

Mo

Mo$(\alpha,\alpha'\gamma)$ $E_\alpha = 3.0$
γ 0.198 scin

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93,351 (1954).

Capture γ's Mo(n,γ) s pr

0.7†	6.39	0.2†	7.66
1.1†	6.66	0.1†	7.79
3.1†	6.92	0.5†	8.39*
0.3†	7.40	0.08†	9.15
0.7†	7.54*		

Also graph $E_\gamma = 2.7$ to 9.2
*Fit with known Mo^{96} levels if 9.15 γ is Mo^{96} g.s. transition
†Photons per 100 n captures

B.B.Kinsey, G.A.Bartholomew, Can. J. Phys. 31, 1051(1953).

Mo^{93} 42 51 6.9^h

$(0.26\gamma)(0.69\gamma)(\theta)$ $(0.26\gamma)(1.48\gamma)(\theta)$
$(0.69\gamma)(1.48\gamma)(\theta)$
I = 23/2, 15/2, 11/2, 7/2

J.J.Kraushaar, Phys. Rev. 92, 318 (1953).

Mo^{95} 42 53 stable

I 5/2 Mo^{95} S
μ negative
$\mu(Mo^{97})/\mu(Mo^{95})$ = 1.022

E.C.Woodward, Jr., Phys. Rev. 93, 954A(1954).

Mo^{97} 42 55 stable

I 5/2 Mo^{97} S
μ negative
$\mu(Mo^{97})/\mu(Mo^{95})$ = 1.022

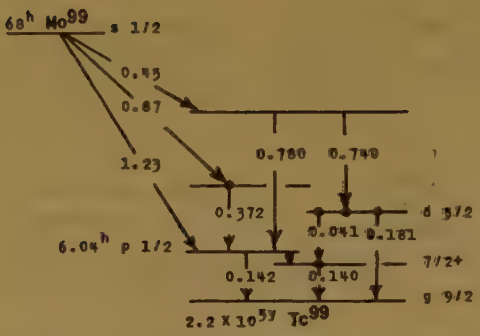
E.C.Woodward, Jr., Phys. Rev. 93, 954A (1954).

Mo^{99} 42 57 68^h

β^- 14% (0.45) $\beta\gamma$ scin
~1% 0.87 Mo(slow n)
85% (1.23)
γ 0.041 $\alpha\sim5$ 0.372 scin
0.140 0.740
0.181 (0.780)
$(0.87\,\beta)(0.372\gamma)$ No $(1.23\,\beta)\,\gamma$
$(0.740\gamma)(0.041\gamma, 0.140\gamma, 0.181\gamma)$
$(0.041\gamma)(0.140\gamma)$ No $(0.372\gamma)\gamma$
No $(0.780\gamma)(0.041\gamma, 0.140\gamma, 0.181\gamma)$

J.Varma, C.E.Mandeville, Phys. Rev. 94, 91, 760A(1954); J.Franklin Inst. 256, 573(1953).

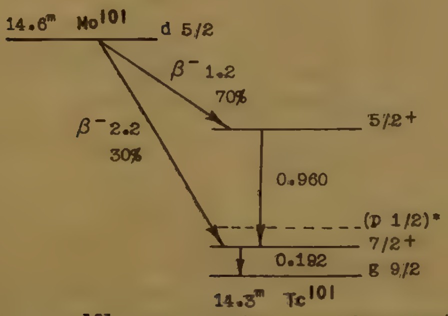
Mo^{99} 42 57 68^h



J.Varma, C.E.Mandeville, Phys. Rev. 94, 91 780A(1954); J.Franklin Inst. 256, 573(1953).

Mo^{101} 42 59 14.6^m

τ		14.6^m	Mo^{100} (15-Mev d)	
β^-	70%	1.2		a
	30%	2.2		
γ		0.20		scin
		0.96		



*Lack of Tc^{101} isomer implies p 1/2 above 7/2+
See also Tc^{101}.

D.R.Wiles, Phys. Rev. 93, 181 (1954).

Tc^{93} 43 50 43.5^m

0.39γ assigned to $43.5^m Tc^{93}$ ms

R.Bermas, J.Beyden, L.Papineau, Compt. rend. 238, 791 (1954).

Tc^{98} 43 55 ?

~42^m activity not assignable to Tc^{98}
Mo^{98} (7.4-Mev p) Mo^{95} (20-Mev α)

J.K.Lerohl, M.L.Pool, B.N.Kundu, R.A.House, Phys. Rev. 92, 934(1953).

Tc^{99} 43 56 2.2×10^{5y}

I	9/2	B
μ	5.6	
Q	+0.3	

K.G.Kessler, R.E.Trees, Phys. Rev. 92, 303, (1953).

Tc^{101} 43 58 14.3^m

τ	14.3^m	Mo^{100} (15-Mev d)	chem
β^-	1.4		a
γ	0.30		scin

No isomer with $\tau > 3^m$ or $<2^d$ found from decay of 14.6^mMo. All long-lived Tc found ascribed to $60^d Tc^{95}$ and $90^d Tc^{97}$

D.R.Wiles, Phys. Rev. 93, 181 (1954).

Ru

Relative abundances $C_{10}H_{10}Ru$ ms

%	A	%	A
5.50	96	17.01	101
1.91	98	31.52	102
12.70	99	18.67	104
12.69	100		

L.Friedman, A.P.Irsa, J. Am. Chem. Soc. 75, 5741 (1953).

	Ru(α,α'γ)	E_α = 3.0	
γ	0.091		scin
	0.128		
	0.260		

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 93, 906 (1954).

Resonances Ru(n) E_n = 1 to 1000ev time of flight

E_o (ev)	$\sigma_o \Gamma^2$
9.8	15
15.2	14
24.1	18.0
40.9	82.0

E.Melkonian, W.W.Havens, Jr., L.J.Rainwater, Phys. Rev. 92, 702 (1953).

$Rh^{98?}$ 45 53 9^m

τ	9^m	d 15^mPd	chem
β^+	4.0		a

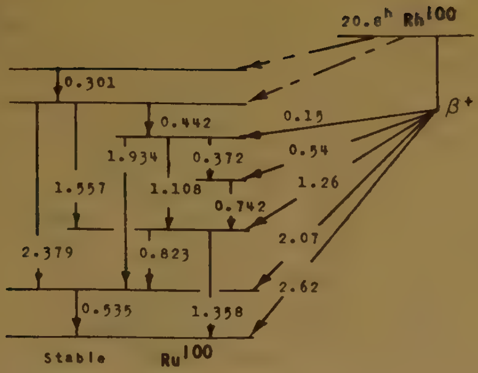
A.H.W.Aten, Jr., T. de Vries-Hamerling, Physica 19, 1200 (1953).

Rh^{100} 45 55 20.8^h

τ		20.8^h		d 4.0^dPd	
β^+	0.06†	0.15			sl
	3.6 †	0.54			
	13 †	1.26			
	39 †	2.07			
	45 †	2.62	F-K probably linear		
γ	5.3 *	0.301	1.5*	1.108	
	0.9 *	0.372	2.8*	1.358	
	21.3 *	0.442	1.1*	1.557	
	100.0 *	0.535	0.4*	1.934	
	0.6 *	0.742	1.0*	2.379	
	9.7 *	0.823	*Rel. intensity ce^-		

$(ce^-\ 0.535\gamma)/\beta^+ = 0.062$ $\beta^+/\epsilon = 0.05$ (est.)

Rh^{100}
45 55
20.8^h



L.Marquez, Phys. Rev. 92, 1511 (1953).

Rh^{103}
45 58
stable

γ $Rh^{103}(\alpha,\alpha'\gamma)$ $E_a = 3.0$ scin
0.305
0.370

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93,351 (1954).

Rh^{104}
45 59
4.3^m

γ (0.051) $\alpha_K = 1.9$ scin

E.Germagnoli, A.Malvicini, L.Zappa, Nuovo Cim. 10, 1388 (1953).

Rh^{104}
45 59
44^s

γ 0.552 scin
No other γ with $E_\gamma > 0.2$

E.Germagnoli, A.Malvicini, L.Zappa, Nuovo Cim. 10, 1388 (1953).

Capture γ's Rh^{103}(n) s pr

0.5†	5.55	0.7†	6.20
0.5†	5.91	0.2†	6.36
0.6†	6.06	0.2†	6.79

Also graph $E_\gamma = 3$ to 7.2
$B_n(Rh^{103}) = 6.8$ from Rh^{103}(d,p)
†Photons per 100 n captures

G.A.Bartholomew, B.B.Kinsey, Can. J. Phys. 31, 1025 (1953).

Resonance $Rh^{103}(n,\gamma)$
1.26ev $\sigma_o = \sim 4850$ cryst s

H.H.Landon, Phys. Rev. 93, 931A (1954).

Resonance Rh^{103}(n)
(1.26)ev J = 1
$\Gamma_n/\Gamma = 0.004 \pm 0.008$

B.N.Brockhouse, Can. J. Phys. 31, 432 (1953).

Rh^{105}
45 60
36.5^h

β^- 4% ~0.21 Ru(pile n) chem
96% (0.57) $\alpha\beta\gamma$
γ 0.32 scin
($\sim 0.21\beta$)(0.32γ)

C.Levi, L.Papineau, Compt. rend. 238,1407 (1954).

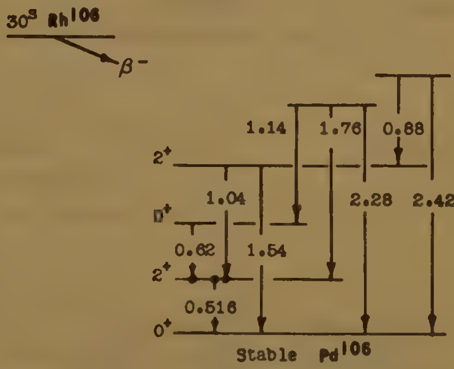
Rh^{106}
45 61
30^s

(0.624γ)(0.513γ)(θ) I = 0, 2, 0 scin
(1.045γ)(0.513γ)(θ) I = 2, 2, 0
$\gamma\gamma(\theta)$ coefficients differ by 3% from theory
No (0.870γ)(1.045γ)

E.D.Klema, F.K.McGowan, Phys. Rev. 92,1469, (1953).

γ 20.5†	0.516		d 1.0^yRu	scin
10.4†	0.619	0.2†	1.54	
0.3†	0.88	<0.1†	1.76	
1.7†	1.04	<0.1†	2.28	
0.4†	1.14	<0.1†	2.42	

†Photons per 100 disintegrations



B.Kahn, W.S.Lyon, Phys. Rev. 92,902 (1953).

Pd

Resonances Pd(n) $E_n = 1$ to 50 ev
w 13.3 ev cryst s
w 26 ev
st 34.1 ev (Pd^{109}?)

H.H.Landon, V.L.Sailor, Phys. Rev. 93,1030 (1954).

$Pd^{98?}$
46 52
15^m

τ 15^m Ru(52-Mev α) chem
p 9^mRh chem

A.H.W.Aten, Jr., T. de Vries-Hamerling, Physica 19, 1200 (1953).

$Pd^{100?}$
46 54
4.0^d

γ 0.0807 sl ce$^-$
In 4^d activity with 21^hRh from Ag(420-Mev p)

L.Marquez, Phys. Rev. 92, 1511 (1953).

Pd^{103} 46 57 17^d

γ (0.040) K/LM = 0.16 pc
$\alpha_K = 70$

$E_\epsilon = 0.036$ from $\epsilon_M/\epsilon_L = 1.3$

$E_{dis} = 0.036 + 0.040$ (E_γ)

P. Avignon, J. Phys. radium 14, 637 (1953).

Rh^{103} (20-Mev d) chem

γ	4†	0.26 ?	scin
	11†	0.305	
	60†	0.367	
	11†	0.503	

$E_{dis} = 0.53 + 0.040$ (E_γ) scin
from continuous γ endpoint
†Photons per 10^4 disintegrations

L.M.Th.Rietjens, H.J.Van den Bold, P.M.Endt, Physica 20, 107 (1954).

$Pd^{105?}$ 46 59 stable

Pd($\alpha,\alpha'\gamma$) $E_\alpha = 3.0$
γ 0.068? scin

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93,351 (1954).

Pd^{113} 46 67 1.5^m

τ 1.5^m p 5.3^h Ag chem
U(190-Mev d) chem

H.G.Hicks, R.S.Gilbert, Phys. Rev. 94,371(1954)

Ag

Capture γ's Ag(n,γ) s pr

1.1†	6.06	0.1†	6.95
0.4†	6.27	0.3†	7.06
0.4†	6.55	0.4†	7.27
0.2†	6.67		

Also graph $E_\gamma = 3$ to 7.4
$B_n(Ag^{107?}) = 7.0$ from Ag(d,p)
†Photons per 100 n captures

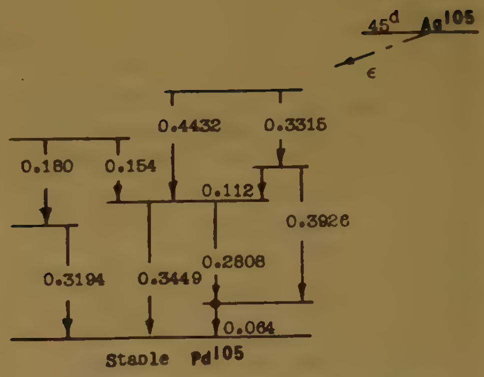
G.A.Bartholomew, B.B.Kinsey, Can. J. Phys. 31, 1025(1953).

Ag($\alpha,\alpha'\gamma$) $E_\alpha = 3.0$
γ 0.321 scin
0.430

Ag^{105} 47 58 45^d

γ	0.0640		d 54.7^mCd
	0.2808	$K/L_1 \geq 5$	sm ce^- ppl
	0.3194		
	0.3315		
	0.3449	$K/L_1 \geq 5$	
	0.3926		
	0.4432		

Ag^{105} 47 58 45^d



F.A.Johnson, Can. J. Phys. 31, 1136 (1953).

Ag^{107} 47 60 44^s

γ 0.0930 d 6.7^hCd sm ce^-
$L_1 : L_2 : L_3 = 0.2 : 1 : 1$

F.A.Johnson, Can. J. Phys. 31,1136(1953).

γ (0.094) $\alpha_K = 9.5$ E3 d 6.7^hCd
K/LM = 0.88 scin, sl ce^-

J.Brunner, O.Huber, R.Joly, D.Maeder, Helv. Phys. Acta 26, 588A(1953).

Ag^{107} 47 60 stable

μ −0.11305 $AgNO_3$ 1
$\nu(Ag^{107})/\nu(Ag^{109}) = 0.86985$ *1*
$\nu(Ag^{109})/\nu(D) = 0.30316$ *3*

P.B.Sogo, C.D.Jeffries, Phys. Rev. 93, 174 (1954).

μ −0.113014 $AgNO_3$ 1
$\nu(Ag^{107})/\nu(H) = 0.040468$ *1*

E.Brun, J.Oeser, H.H.Staub, C.G.Telschow, Phys. Rev. 93, 172 (1954).

Ag^{107}($\alpha,\alpha'\gamma$) $E_\alpha = 3.0$
0.333 scin
0.442

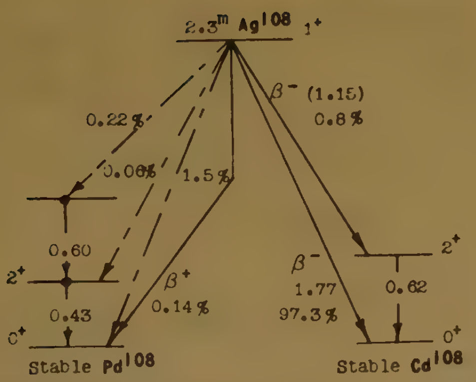
G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93,351 (1954); priv. comm.

Ag^{108} 47 61 2.3^m

β^-	(0.8%)	(1.15)	Ag(pile n)	scin
	97.3%	1.77		
γ	100†	0.43		scin
	79†	0.60		
		0.62		

No 1.03γ No 0.19γ
(K x ray)(0.43γ,0.60γ) (0.60γ)(0.43γ)
No β^+ γ
$\epsilon_K/\beta^- = 0.016$ pc
15% ϵ to excited levels xγ/x
$\beta^+/\beta^- = 0.0014$

Ag^{108} 47 61 2.3^m



M.L.Perlman, W.Bernstein, R.B.Schwartz, Phys. Rev. 92, 1236 (1953).

Ag^{109} 47 62 40^s

γ 0.0879 d 470^dCd $s\pi$ ce^-

F.A.Johnson, Can. J. Phys. 31,1136(1953).

γ 0.087 $\alpha_K \sim 8.6$ E3 d 13^hPd; pc

P. Avignon, J. phys. radium 14, 636 (1953).

γ (0.087) $\alpha_K = 12.4$ E3 d 470^dCd
K/LM = 0.85 scin, slce$^-$

J.Brunner, O.Huber, R.Joly, D.Maeder, Helv. Phys. Acta 26, 588A(1953).

Ag^{109} 47 62 stable

μ −0.12996 $AgNO_3$ I
$\nu(Ag^{109})/\nu$ (D) = 0.30316 3

P.B.Sogo, C.D.Jeffries, Phys. Rev. 93, 174 (1954).

μ −0.129923 $AgNO_3$ I
$\nu(Ag^{109})/\nu$ (H) = 0.046523 1

E.Brun, J.Oeser, H.H.Staub, C.G.Telschow; Phys. Rev. 93, 172 (1954).

Ag^{110} 47 63 270^d

β^-	107†	0.080	sl
	32†	0.314	
	153†	0.530	

T.Azuma, Phys. Rev. 94, 638 (1954).

Cd

Cd($\alpha,\alpha'\gamma$) $E_\alpha = 3.0$
γ 0.300? scin

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93,351 (1954).

Cd^{105} 48 57 54.7^m

τ 54.7^m Ag(20-Mev p) chem
β^+ 0.80 sl
1.691
γ 0.0255 $L_2L_3/MN = 4$ $L_2 \ll L_3$
0.0277 $s\pi$ ce^-

0.2630	0.3249	1.908
0.2925	0.3363	1.96
0.3080*	0.3407	2.00
0.3121	0.3470*	2.045
0.3171	0.4331*	2.277
0.3205*	0.6067	2.32

No $\beta^+\gamma$ for $E_\gamma > 0.5$
*Most intense lines

F.A.Johnson, Can. J. Phys. 31,1136(1953); Proc. Roy. Soc. Canada, 46,135A(1952).

Cd^{107} 48 59 6.7^h

$\beta^+/0.85\gamma = 0.66 \pm 0.05$ scin

D.Maeder, R.Müller, V.Wintersteiger, Helv. Phys. Acta 27, 3 (1954).

Cd^{109} 48 61 470^d

$E_\epsilon = 0.07$ from $\epsilon_L/\epsilon_K = 0.28$ 3 4π scin
$E_{dis} = 0.07 + 0.087$ (E_γ)

E. der Mateosian, Phys. Rev. 92,938(1953); 87, 193A(1952).

Cd^{111} 48 63 48.7^m

γ (0.15) E3 > 99.7% $\gamma\gamma(\theta)$
(0.15γ) (0.25γ) (θ) I = 11/2, 5/2, 1/2
Molten Cd metal

J.J.Kraushaar, R.V.Pound, Phys. Rev. 92,523, (1953).

Cd^{114} 48 66 stable

Capture γ's Cd(n,γ) s pr

2.2 †	5.94	0.12†	7.84
0.36†	6.82	0.23†	8.483
0.21†	7.67	0.14†	9.046
0.16†	7.73		

Also graph E_γ = 2.8 to 9.5
$B_n(Cd^{113}) \sim 9$ from mass measurements
†Photons per 100 n captures in Cd

B.B.Kinsey, G.A.Bartholomew, Can. J. Phys. 31, 1051(1953); Phys. Rev. 90, 355A(1953).

Cd^{117} 48 69 3.0^h

γ	0.267	1.27	$s\pi$ ce^-
	0.281	1.55	scin
	0.331*	2.00	
	0.43		
	0.84	Cd^{116} (pile n)	

J.M.LeBlanc, J.M.Cork, S.B.Burson, Phys. Rev. 93, 916A (1954); * verbal report.

In

In(p,p'γ) $E_p = 3.0$
γ 0.500 scin

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93,351 (1954).

In^{114} 49 65 72ˢ

β^+ 0.004% ~1.2 a

γ (0.722) M1 96% E2 4% $\gamma\gamma(\theta)$

$(0.72\gamma)(0.56\gamma)(\theta)$ I = 2, 2, 0

No low energy β^- (<0.1%) $\alpha\beta\gamma$

M.W.Johns, C.C.McMullen, R.J.Donnelly, S.V.Nablo, Can. J. Phys. 32, 35 (1954).

γ 100† (0.556) scin
80† (0.722)
4† (1.271)

D.Maeder, R.Müller, V.Wintersteiger, Helv. Phys. Acta 27, 3 (1954).

γ (0.722) M1 97% E2 3% $\gamma\gamma(\theta)$

$(0.72\gamma)(0.56\gamma)(\theta)$ I = 2, 2, 0

D.G.Alkhazov, I. Kh. Lemberg, A.P.Grinberg, Izvest. Akad. Nauk Ser. Fiz. SSSR 17, 487 (1953); Chem. Abstr. 48-2488a (1954).

In^{115} 49 66 $6x10^{14y}$

In(n,n')4.5ʰIn E_n = 0.4 to 1.8

Levels* 0.60? scin
0.96
1.37
1.75?

*Sharp increases in slope of σ curve

A.A.Ebel, C.Goodman, Phys. Rev. 93,197(1954).

In(n,n')4.5ʰIn E_n = 0.4 to 5.5

Threshold 0.4 scin
Levels* ~1
~1.35

*Flat sections of σ curve

H.C.Martin, B.C.Diven, R.F.Taschek, Phys. Rev. 93, 199 (1954); 92, 1096A (1953).

Levels In(n,n'γ) E_n = 2.5
0.61*
0.92*

γ 0.25 scin
0.24
0.44
0.75 ?
0.87

*Inelastic neutrons detected

E.A.Eliot, D.Hicks, L.E.Beghian, H.Halban, Phys. Rev. 94, 144 (1954).

In^{116} 49 67 13ˢ

τ_2 13ˢ Sn(14-Mev n)

β^- ~2.8 a

Z.Wilhelmi, R.Brunsz, C.Dabrowski, Bull. Acad Polon. Sci. 1, 105 (1953).

In^{116} 49 67 13ˢ

Capture γ's In(n,γ) s pr

1.1†	4.97	0.4†	5.55
1.0†	5.17	0.3†	5.73
0.8†	5.34	0.7†	5.86

Also graph E_γ = 3 to 8.2

$B_n(In^{115})$ = 6.6 from In(d,p)

†Photons per 100 n captures in In

G.A.Bartholomew, B.B.Kinsey, Can. J. Phys. 31, 1025(1953).

Resonance In(n)
(1.45)ev J = 4

Γ_n/Γ = 0.043 ± 0.006

B.N.Brockhouse, Can. J. Phys. 31,432 (1953).

In^{117} 49 68 1.9ʰ

τ_1 2.3ʰ
γ 0.160 sr ce⁻
IT 0.312 scin
0.562*
0.725*

No $\beta(0.312\gamma)$

J.M.LeBlanc, J.M.Cork, S.B.Burson, Phys. Rev. 93, 916A(1954); * verbal report.

τ_1 1.90ʰ d 50ᵐCd chem

β^- 30% 1.616 sl ce⁻
70% 1.772

γ 0.161 α_K = 0.13 M1 sl ce⁻,
0.311 α_K = 1.3 M4 scin

$(\beta)(0.16\gamma)$ No $(0.31\gamma)(\beta,\gamma)$

p 1.1ʰIn 28% Not d 3.0ʰCd (< 10%)

C.L.McGinnis, Phys. Rev. 94, 780A (1954); verbal report.

In^{117} 49 68 1.1ʰ

τ_2 1.1ʰ d 3.0ʰCd chem

β^- 0.740 sl

γ 86† 0.161 α_K = 0.13 scin, sl ce⁻
100† 0.565 α_K ~ 0.005

$(\beta)(0.16\gamma, 0.57\gamma)$ $(0.16\gamma)(0.57\gamma)$

No 0.726 γ (< 1†)

d 1.9ʰIn 28% Not p 14ᵈ Sn (< 1%)

C.L.McGinnis, Phys. Rev. 94, 780A(1954); verbal report.

In^{118} 49 69 4.5ᵐ

τ_1 4.5ᵐ Sn(14-Mev n)

Z.Wilhelmi, R.Brunsz, C.Dabrowski, Bull. Acad Polon. Sci. 1, 105 (1953).

Sn

Sn($\alpha,\alpha'\gamma$) E_α = 3.0

No γ scin

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 93,906 (1954).

Sn
Capture γ's Sn(n,γ) s pr
0.4† 9.35
Also graph $E_\gamma = 3$ to 9.5
†Photons per 100 n captures

B.B.Kinsey, G.A.Bartholomew, Can. J. Phys. 31, 1051 (1953).

Sb
Sb(α,α′γ) $E_\alpha = 3.0$
γ 0.16 scin

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93, 351 (1954).

Capture γ's Sb(n,γ) s pr
0.5† 5.48 1.1† 6.33
1† 5.61 1.6† 6.50
1† 5.88 0.7† 6.80
1† 6.11
Also graph $E_\gamma = 3$ to 8
$B_n(Sb^{121?}) = 6.6$ from Sb(d,p)
†Photons per 100 n captures

G.A.Bartholomew, B.B.Kinsey, Can. J. Phys. 31, 1025 (1953).

Sb^{121} 51 70 stable
q −0.5 Sb^{121} S

K.Murakawa, Phys. Rev. 93, 1232 (1954).

q −1.3 S
Based on $q(Sb^{123})/q(Sb^{121}) = 1.26$*

G.Sprague, D.H.Tomboulian, Phys. Rev. 92,105 (1953); 91,476A(1953); *H.G.Dehmelt, H.Kruger Z.Physik 130, 385 (1951).

Sb^{122} 51 71 2.75^d
τ 2.75^d Sb^{121}(pile n)
β^- 8† ~0.45 $s\pi\sqrt{2}$
56† 1.40 F-K plot not linear
36† 2.00 $\Delta I = 2$, yes shape
No β^+
γ 0.095 sπ ce^-, scin
0.553 K/L~1 0.694
s 0.566 K/L = 7 1.10
0.616 1.27
w 0.647 1.97
x K x ray
(0.566 γ)(1.4 β, 0.694 γ)

J.M.Cork, M.K.Brice, G.D.Hickman, L.C.Schmid, Phys. Rev. 93, 1059 (1954).

Sb^{123} 51 72 stable
q −0.7 Sb^{123} S

K.Murakawa, Phys. Rev. 93, 1232 (1954).

q −1.7 S

G.Sprague, D.H.Tomboulian, Phys. Rev. 92,105 (1953); 91, 476A(1953).

Sb^{124} 51 73 60^d
β^- 0.360 0.925 s
0.582 1.585
0.745 2.295
γ 0.607 0.840 s pe^-
0.658 1.720
0.713 2.03

K.C.Mann, R.M.Pearce, Proc. Roy. Soc. Canada 47, 130A (1953).

γ (0.60) E2
(2.27β)(0.60γ) polarization-direction

D.R.Hamilton, A.Lemonick, F.M.Pipkin, Phys. Rev. 92, 1191(1953); 90, 370A(1953).

(0.64γ)(0.72γ)(0.60γ) scin

L.M.Langer, J.W.Starner, Phys. Rev. 93, 253 (1954).

Te
Te(α,α′γ) $E_\alpha = 3.0$
No γ scin

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93,351 (1954).

Resonance Te(n)
2.33ev $\sigma_0 = 668$ $\Gamma = 0.114$

H.L.Foote, Jr., Phys. Rev. 94, 790A(1954).

Te^{121} 52 69 154^d
γ (0.213) E2 5.8%
(ce_K^- 0.082γ)(0.213γ)(θ)

N.Goldberg, S.Frankel, Phys. Rev. 93,1425 (1954).

Te^{123} 52 71 104^d
γ Te^{122}(pile n)
0.159 $\alpha_K = 0.19$ M1 scin
From x/γ in spectrum coincident with ce_L^- of 0.088γ

F.K.McGowan, Phys. Rev. 93, 163 (1954).

γ (0.159) E2 1.2%
(ce_K^- 0.089γ)(0.159γ)(θ)

N.Goldberg, S.Frankel, Phys. Rev. 93,1425 (1954).

$I^{119?}$ 53 66 18^m
τ 18^m Pd(~100-Mev N) chem

G.B.Rossi, W.B.Jones, J.M.Hollander, J.G.Hamilton, Phys. Rev. 93, 256 (1954).

I^{121} 53 68 1.4^h
τ 1.4^h Pd(~100-Mev N) chem

G.B.Rossi, W.B.Jones, J.M.Hollander, J.G.Hamilton, Phys. Rev. 93, 256 (1954).

I^{125} 53 72 60^d
$E_\epsilon = 0.11$ from $\epsilon_L/\epsilon_K = 0.23$ 3 4π scin
$E_{dis} = 0.11 + 0.035$ (E_γ)

E. der Mateosian, Phys. Rev. 92,938(1953); 87, 193A(1952).

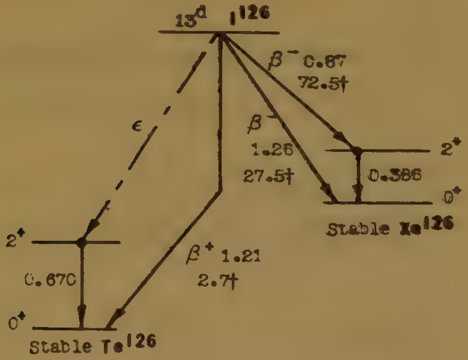
I^{126} 53 73 13^d

β^-	72.5†	0.87	I(28-Mev d) chem; sl
	27.5†	1.26	
β^+	2.7†	1.21	
γ			sl ce^- pe^-; scin
		0.386	$\alpha_K = 0.016$ K/LM ≥ 8
		0.670	

No 0.54 β^+ (<1.3†)

(0.87β) (0.39γ) (K X ray) (0.67γ)

$\epsilon_K/(0.67\gamma) = 1.35$ $(0.67\gamma)/(0.39\gamma) = 1.0$



N.Marty, M.Langevin, P.Hubert, J.Phys.radium 14,663 (1953); Compt. rend. 236,1153 (1953).

I^{127} 53 74 stable

	$I^{127}(\alpha,\alpha'\gamma)$	$E_\alpha = 3.0$	
γ	0.057		scin
	0.205		

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 93,906 (1954).

Q -0.819 M

V.Jaccarino, J.G.King, H.H.Stroke, quoted by R.Livingston, et al Phys. Rev. 92,1271(1953).

I^{128} 53 75 25.0^m

γ 0.436 scin

E.Germagnoli, A.Malvicini, L.Zappa, Nuovo Cim. 10, 1388 (1953).

I^{130} 53 77 12.5^h

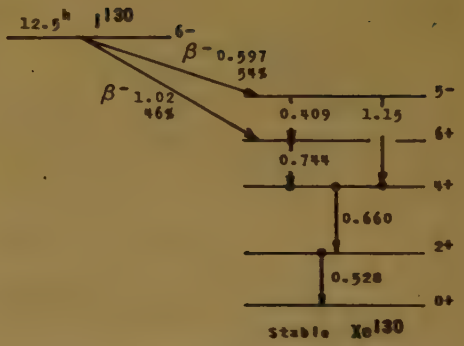
			Te^{130}(11-Mev d) chem		
β^-	54%	0.597			sl
	46%	1.02			
			$\alpha_K(x10^3)$	K/LM	
γ	30†	0.409	16	11	
	100†	0.528	5.5	8	E2
	90†	0.660	3.2	16	E2
	80†	0.744	2.7	4	E2
	40†	1.15	0.25		E1

(0.744γ)(0.660γ, 0.528γ, 0.409γ)

(1.15γ)(0.660γ, 0.528γ)

No β^- with E_β > 1.02

I^{130} 53 77 12.5^h



R.S.Caird, A.C.G.Mitchell, Phys. Rev. 94,412, 780A (1954).

I^{131} 53 78 8.05^d

I	7/2	CH_3I^{131}	Mic
Q	-0.412*		

Q $(I^{131})/Q(I^{127})$ = 0.5051

*Based on Q(I^{127}) = -0.819 (See I^{127})

R.Livingston, B.M.Benjamin, J.T.Cox, W.Gordy, Phys. Rev. 92, 1271 (1953).

Xe^{129} 54 75 stable

μ -0.77254 Xe I

$\nu(Xe^{129})/\nu(H)$ = 0.276833 5

E.Brun, J.Oeser, H.H.Staub, C.G.Telschow, Phys. Rev. 93, 904 (1954).

Xe^{131} 54 77 stable

μ +0.68680 Xe I

$\nu(Xe^{131})/\nu(H)$ = 0.081978 1

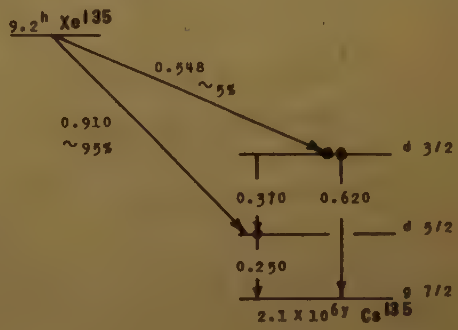
E.Brun, J.Oeser, H.H.Staub, C.G.Telschow, Phys. Rev. 93, 904 (1954).

Xe^{135} 54 81 9.2^h

β^-	~ 5%	0.548	$\beta\gamma$ sl
	~ 95%	(0.910)	
γ		0.250	scin
		0.37	
		0.60	

(0.548 β) (0.60 γ)

(ce_K^- 0.25 γ) (0.37 γ) No (ce_K^- 0.25 γ) (0.60 γ)



S.Thulin, Phys. Rev. 94, 734 (1954).

Cs^{125} 55 70 45^m

τ 45^m $I^{127}(\alpha)$chem; ms

M.C.Michel, D.H.Templeton, Phys. Rev. 93,1422 (1954).

Cs^{127} 55 72 6.1^h

τ 6.1^h $I^{127}(\alpha)$ chem; ms

M.C.Michel, D.H.Templeton, Phys. Rev. 93,1422 (1954).

Cs^{129} 55 74 30^m

τ 30^m $I^{127}(\alpha)$ chem; ms

M.C.Michel, D.H.Templeton, Phys. Rev. 93,1422 (1954).

Cs^{131} 55 76 10^d

E_{dis} 0.353 d 13^d Ba chem
From continuous γ endpoint scin
No 0.080γ ($<10^{-7}$/dis) crit a
Not p 12.0^{d}Xe ($<10^{-8}$%) Xe separation

B.Saraf, Phys. Rev. 94, 642, 793A (1954); J. Franklin Inst. 257, 248 (1954).

Cs^{133} 55 78 stable

$Cs^{133}(\alpha,\alpha'\gamma)$ $E_\alpha = 3.0$
γ 0.085 scin

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93,351 (1954).

Cs^{134} 55 79 2.3^y

γ (0.57) M1 $\gamma\gamma(\theta)$
$\gamma\gamma(\theta)$ I = 5, 4, 2, 0

D.G.Alkhazov, I. Kh. Lemberg, A.P.Grinberg, Izvest. Akad. Nauk Ser. Fiz. SSSR 17, 487 (1953); Chem. Abstr. 48-2488a (1954).

Resonance Cs^{133}(n) cryst s
5.90 ev $\sigma_0 \sim 9500$ $\Gamma = 0.12$

H.H.Landon, V.L.Sailor, Phys. Rev. 93,1030 (1954).

Cs^{137} 55 82 33^y

β^- 0.523 $\Delta I = 2$, yes shape sl

J.L.Olsen, G.D.O'Kelley, Phys. Rev. 93,1125 (1954).

β^- 0.518 $\Delta I = 2$ yes shape sl
γ 0.663 $\alpha_K = 0.096$
K : L : M = 4.6 : 1 : 0.07

T.Azuma, J. Phys. Soc., Japan 9, 1 (1954).

Ba

Capture γ's Ba(n,γ) s pr

5†	3.66	0.4†	6.44
13†	4.10	0.4†	6.68
3†	4.70	0.1†	7.18
1†	4.98	0.1†	7.79
3.7†	5.74	0.1†	9.23
1†	6.06		

Also graph $E_\gamma = 2.5$ to 9.5
Ba(γ,n) thresholds known at 6.8 and 8.6
†Photons per 100 n captures

B.B.Kinsey, G.A.Bartholomew, Can. J. Phys. 31, 1051 (1953).

Ba

Ba($\alpha,\alpha'\gamma$) $E_\alpha = 3.0$
γ 0.060 scin
0.118

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 93,906 (1954).

Ba^{133} 56 77 10^y

γ 1†	0.057		Ba(pile n) scin
22†	0.082	$\alpha = 3.5$ M1	
31†	0.300		
69†	0.357		

(0.082γ)(0.057γ, 0.300γ, 0.357γ)
(0.057γ)(0.300γ) No (0.357γ)(0.300γ, 0.057γ)

R.W.Hayward, D.D.Hoppes, H.Ernst, Phys. Rev. 93, 916A (1954).

Cs^{133}(7-Mev d) chem
γ 0.073 crit a, scin
0.082
0.294
0.363
No β^+ ($<0.1\%$)

M.Langevin, Compt. rend. 238, 1310 (1954).

Ba^{137} 56 81 2.60^m

d 2.3^yCs
γ 0.661 $\alpha_K = 0.11$ M4 s
K : L : M = 6 : 1 : 0.24

V.M.Dolishnyuk, G.M.Drabkin, V.I.Orlov, L.I.Rusinov, Doklady Akad. Nauk SSSR 92,1141 (1953); NSF-tr-229.

La^{139} 57 82 stable

La($\alpha,\alpha'\gamma$) $E_\alpha = 3.0$
γ 0.056 scin

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 93,906 (1954).

Q 0.9 S

K.Murakawa, T.Kamei, Phys. Rev. 92,325 (1953).

La^{140} 57 83 40.2^h

τ 40.22^h 2 d 13^dBa chem
Counted for 14 half-lives

H.W.Kirby, M.L.Salutsky, Phys. Rev. 93, 1051 (1954).

β^- 12% 0.83 d 13^dBa chem; sm
26% 1.10
45% 1.34
10% 1.67
7% 2.15

γ 0.110	10†	0.328	sm ce$^-$,
0.130	10†	0.485	pe$^-$
0.240	10†	0.815	
0.270	100†	1.60	

C.L.Peacock, J.F.Quinn, A.W.Oser, Jr., Phys. Rev. 94, 372, 804A (1954).

Ce? Ce$(\alpha,\alpha'\gamma)$ $E_\alpha = 3.0$

γ	0.077	scin
	0.129	

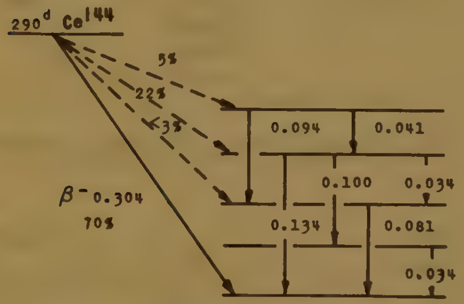
N.P.Heydenburg, G.M.Temmer, Phys. Rev. 93,906 (1954).

Ce^{144} 58 86 290^d

β^-	70%	0.304		U(n,f)chem;	sl	
			K/L	L/M	sl ce$^-$	
γ	15†	0.034		3		
	12†	0.041		11		
	3†	0.053				
	59†	0.081	5	9	M2	
	7†	0.094				
	5†	0.100				
	115†	0.134	8	≥4	M1	

$(0.134\gamma)/(0.081\gamma) \sim 15$ scin

†Relative intensity ce$^-$



W.S.Emmerich, W.J.Auth, J.D.Kurbatov, Phys. Rev. 94, 110; 794A (1954).

Ce^{145}? 58 87 3^m

τ	3.0^m	U(pile n)	chem;p 6^hPr
β^-	~2.0		a
γ's			

S.S.Markowitz, W.Bernstein, S.Katcoff, Phys. Rev. 93, 178 (1954).

Ce^{146} 58 88 14^m

β^-		0.7	U(n,f) chem;	scin
γ	w	0.05		scin
	20†	0.110		
	42†	0.142		
	50†	0.22		
	w	0.25		
	12†	0.27		
	100†	0.32		

$(0.05\gamma)(0.27\gamma)$ $(0.110\gamma)(0.22\gamma, 0.25\gamma)$

$(0.142\gamma)(0.22\gamma)$ No$(0.32\gamma)(\gamma)$

β(all γ's)

W.Bernstein, S.S.Markowitz, S.Katcoff, Phys. Rev. 93, 1073 (1954).

Pr^{141} 59 82 stable

$Pr^{141}(\alpha,\alpha'\gamma)$ $E_\alpha = 3.0$

γ 0.15 scin

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93,351 (1954).

Pr^{142} 59 83 19.2^h

Capture γ's $Pr^{141}(n,\gamma)$ s pr

3†	4.69	3†	5.67
2†	4.79	2†	5.83
3†	5.16		

Also graph $E_\gamma = 2.5$ to 6.5

$B_n(Pr^{141}) = 5.65$ from Pr^{141}(d,p)*

†Photons per 100 n captures

G.A.Bartholomew, B.B.Kinsey, Can. J. Phys. 31, 1025 (1953); *M.S.Wall, priv. comm.

Pr^{144} 59 85 17.5^m

β^-	3%	0.8	d 290^dCe	sl
	2%	2.3		
	95%	2.98		
γ		0.060 ?	K/L=1	sl ce$^-$(Nd)
		(0.695)		scin
		(1.480)		
		(2.185)		

No 0.060 photon scin

W.S.Emmerich, W.J.Auth, J.D.Kurbatov, Phys. Rev. 94, 110, 794A (1954).

Pr^{145}? 59 86 6.0^h

τ	6.0^h	d 3^mfission Ce chem
β^-	~1.7	a

S.S.Markowitz, W.Bernstein, S.Katcoff, Phys. Rev. 93, 178 (1954).

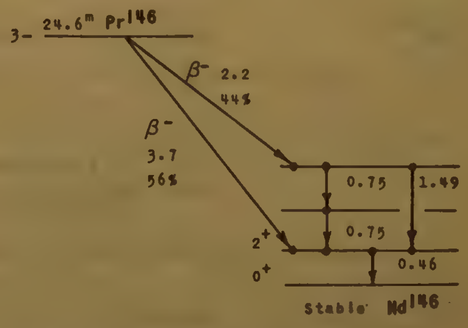
Pr^{146} 59 87 24.6^m

β^-	44†	2.3	d 14^mCe chem;	scin
	56†	3.7		
γ	100†	0.46		scin
	w	0.59?		
	22†	0.75	(double)	
	33†	1.49		

$(0.46\gamma)(3.7\beta^-, 0.75\gamma, 1.49\gamma)$

$(2.3\beta^-)(0.75\gamma, 1.49\gamma)$ $(0.75\gamma)(0.75\gamma)$

No$(0.59\gamma)(\gamma)$ No$(0.75\gamma)(1.49\gamma)$



W.Bernstein, S.S.Markowitz, S.Katcoff, Phys. Rev. 93, 1073 (1954).

Nd Nd$(\alpha,\alpha'\gamma)$ $E_\alpha = 3.0$

γ	0.070	scin
	0.130	

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 93,906 (1954).

Nd^{143} 60 83 stable

$|\mu|$ 1.0 para

Q ~1

$\mu(Nd^{143})/\mu(Nd^{145}) = 1.6083 \pm 0.0012$

B.Bleaney, H.E.D.Scovil, R.S.Trenam, Proc. Roy. Soc. 223A, 15 (1954).

Nd^{144} 60 84 $\sim 1.5 \times 10^{15y}$

τ $\sim 1.5 \times 10^{15y}$ ppl

α 1.9

Natural Nd purified to constant α spectrum

Shell model suggests Nd^{144} assignment

E.C.Waldron, V.A.Schultz, T.P.Kohman, Phys. Rev. 93, 254 (1954).

Nd^{145} 60 85 stable

$|\mu|$ 0.62 para

Q ~1

B.Bleaney, H.E.D.Scovil, R.S.Trenam, Proc. Roy. Soc. 223A, 15 (1954).

Sm

Sm($\alpha,\alpha'\gamma$) $E_\alpha = 3.0$

γ 0.082 scin

0.122

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 93,906 (1954).

Sm^{146} 62 84 5×10^{7y}

τ 5×10^{7y} Nd(40-Mev α) chem

α 2.55 ppl

τ from yield relative to $410^d Sm^{145}, 47^h Sm^{153}$

D.C.Dunlavey, G.T.Seaborg, Phys. Rev. 92, 206 (1953).

Sm^{147} 62 85 1.5×10^{11y}

I 7/2 s

μ -0.76

$|Q|$ <1

$\mu(Sm^{147})/\mu(Sm^{149}) = 1.20$

K.Murakawa, Phys. Rev. 93, 1232 (1954).

Sm^{149} 62 87 stable

I 7/2 s

μ -0.64

$|Q|$ <1

K.Murakawa, Phys. Rev. 93, 1232 (1954).

Sm^{150} 62 88 stable

Resonance (ev) Sm(n)

0.0962 $\sigma_0 = 111{,}000$ $\Gamma = 0.0655$

Data indicate existence of a lower resonance

A.W.McReynolds, E.Andersen, Phys. Rev. 93,195 (1954).

Sm^{150} 62 88 stable

Resonance (ev) Sm(n) $E_n = 0.08$ to 0.16 ev

0.096 $\Gamma_n/\Gamma = 0.0082$ J = 4

B.N.Brockhouse, Can. J. Phys. 31, 432 (1953).

Capture γ's Sm(n,γ) s pr

0.07†	5.99	0.3†	7.24
0.06†	6.54	0.03†	7.89*
0.04†	6.79		

Also graph $E_\gamma = 2.5$ to 8

*Probably not g.s. γ which would be M3 or E4

†Photons per 100 n captures in Sm

B.B.Kinsey, G.A.Bartholomew, Can. J. Phys. 31, 1051 (1953).

Sm^{153} 62 91 47^h

β^-**	32%*	0.64			sl
	49%	0.70			
	19%	0.81			
γ	100†*	0.0690	$\alpha = 6$	slce$^-$	scin
			K/L > 4.6		
		0.1026	K/L > 6.1		
			$\tau = 4.0 \times 10^{-9s}$		βce$^-$
	0.5†	0.1717	$\tau = 1.4 \times 10^{-10s}$		βce$^-$
	w	0.520			

(0.64 β) (0.069 γ), (0.70 β) (0.1025 γ)

**Spectrum analysed only for $E_\beta > 0.35$

R.L.Graham, J.Walker, Phys. Rev. 94, 794A (1954); * verbal report.

Sm(pile n) $\gamma\gamma$ scin

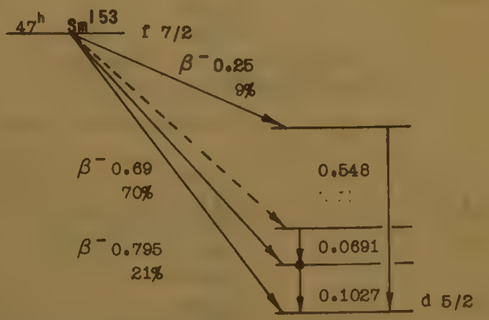
γ 0.070 $\alpha_K = 3.8$ M1 + E2 x/γ

0.102 $\alpha_K = 1.1$ $\tau = 3.4 \times 10^{-9s}$

0.070 γ precedes 0.102γ

F.K.McGowan, Phys. Rev. 93, 163 (1954).

β^-	9%	0.26	Sm^{152} (pile n)		sπ
	70%	0.685			
	21%	0.795			
			α_K	K/L	sπ ce$^-$
γ		0.0691		4	
		0.1027	0.6	6	M1 + E2
		0.548	0.008	6	



M.R.Lee, R.Katz, Phys. Rev. 93,155 (1954); 92, 848A (1953).

Eu^{152} 63 89 13^y

γ		Eu^{151} (pile n)	sm
	0.1212		ce^- (Sm)
	0.2436		ce^- (Gd)
	0.344		ce^- (Gd)
	0.96		a

Eu^{151} impurity in Sm^{152} sample

W.R.Lee, R.Katz, Phys. Rev. 93,155(1954); 85, 1038 (1952).

Eu^{154} 63 91 16^y

β^-	0.71	Eu^{153} (pile n)	sm
γ	0.1224		sm ce^- (Gd)
	1.17		a

Eu^{153} impurity in Sm^{154} sample

W.R.Lee, R.Katz, Phys. Rev. 93, 155(1954); 85, 1038 (1952).

Eu^{155} 63 92 1.7^y

β^-	84%	0.152		sm
	16%	0.252	Sm^{154} (pile n, $\gamma\beta^-$)	
γ		0.0187		sm ce^-
		0.0593		
		0.0858	K/L = ~4	
		0.1045	K/L = 6.1	
		0.1309		
		0.1368		

W.R.Lee, R.Katz, Phys. Rev. 93, 155 (1954).

Gd

	Gd ($\alpha,\alpha'\gamma$)	E_α = 3.0	
γ	0.082		scin
	0.124		

W.P.Heydenburg, G.M.Temmer, Phys. Rev. 93,906 (1954).

Capture γ's	Gd(n,γ)			s pr
0.3†	5.61	0.5†	6.73	
0.2†	5.87	0.03†	7.36	
0.2†	6.41	0.03†	7.78	

Also graph E_γ = 3 to 8
†Photons per 100 n captures

B.B.Kinsey, G.A.Bartholomew, Can. J. Phys. 31, 1051 (1953).

Gd^{159} 64 95 18.0^h

β^-	~0.9	Gd (pile n)	
	~1.1		a$\beta\gamma$
γ	0.0575		sm ce^-
	0.364		

(~0.9β) (0.36γ) (~1.1β) (0.058γ)
No (K x ray) (0.36γ)

W.C.Jordan, J.M.Cork, S.B.Burson, Phys. Rev. 92, 315 (1953).

Gd^{161} 64 97 3.6^m

τ	3.73^m 10	Gd (pile n)	
β^-	~1.6		a
γ	0.102		scin
	0.165 ?		
	0.316		
	0.360		
x	K x ray (Tb)		crit a

(0.102γ) (0.316γ) (0.36γ) (K x ray)
No (0.316γ) (0.36γ)
(β) (all γ's and K x ray)

W.C.Jordan, J.M.Cork, S.B.Burson, Phys. Rev. 92, 315 (1953).

Tb^{149} 65 84 4.1^h

$\alpha/\epsilon > 2 \times 10^{-3}$	Gd (75-Mev p)	chem

M.A.Rollier, J.O.Rasmussen, Jr., Rend. acad. nazl. Lincei 14,526(1953); UCRL-2079.

Tb^{154} 65 89 17.2^h

τ	17.2^h	Eu (38-Mev α)	chem
β^+	1.86		sm 2
	2.75		
ce^-	0.188		
	0.233		
	0.281		
	0.322		
	0.374		
	0.517		
	0.549		

M.A.Rollier, J.O.Rasmussen, Jr., Rend. acad. nazl. Lincei 14,526(1953); UCRL-2079.

Tb^{160} 65 95 73^d

β^-	60%	0.590	s βce^-
	40%	0.850	s

L.Ya Shavtavalov, Izvest. Akad. Nauk Ser. Fiz. 17, 503 (1953); Chem. Abstr. 48-2489d (1954).

γ		K/L		sm ce^-
	0.0863	0.9	$L_1 \ll L_2$	
	0.0934			
	0.1961	~3		
	0.2148	>.2		
	0.2976	>.5		
	0.391			
	0.759			
	0.873	~5		
	0.960	~5		
	1.174			
	1.265			

(0.86 β) (0.086γ, 0.873γ, 0.960γ) a$\beta\gamma$ scin
(0.52 β) (0.086γ, 0.196γ, 0.215γ, 0.298γ)
(0.52 β) (0.873γ, 0.960γ, 1.17γ)
(0.086γ)(0.215γ, 0.298γ, 0.873γ, 1.17γ)
(0.196γ)(0.086γ, 0.215γ, 0.759γ)
(0.215γ)(0.759γ, 0.960γ)
(0.298γ)(0.873γ, 0.960γ)
No 0.306 β No 0.176 γ

S.B.Burson, W.C.Jordan, J.M.LeBlanc, Phys. Rev. 94, 103 (1954).

$Tb^?$ 65 $\sim17^h$

τ	$\sim17^h$	Eu (38-Mev α)	chem
β^-	2.34		sm 2

M.A.Rollier, J.O.Rasmussen, Jr., Rend. acad. nazl. Lincei 14,526(1953); UCRL-2079.

$Tb^?$ 65 $>17^h$

τ	$>17^h$		Eu (38-Mev α)	chem
β^+	3.1			sm 2
ce^-	0.06	0.15		
	0.09	0.21		
	0.13			

M.A.Rollier, J.O.Rasmussen, Jr., Rend. acad. nazl. Lincei 14,526(1953); UCRL-2079.

Dy^{161} 66 95 stable
I 7/2? 8
$\mu(Dy^{161})/\mu(Dy^{163}) \sim 1$

K.Murakawa, T.Kamei, Phys. Rev. 92,325(1953).

Dy^{163} 66 97 stable
I 7/2? 8

K.Murakawa, T.Kamei, Phys. Rev. 92,325(1953).

Dy^{165} 66 99 1.2^m
γ 0.106 K/LM = 0.15 sl ce^-
Dy(slow n)

G.Weber, Z.Naturf. 9A, 115 (1954).

β^- (0.84) (calc) Dy(pile n), $s\pi$ ppl
γ 0.108 $\alpha_K \sim 4$ scin, $s\pi$ ce^- ppl
K : L_I: L_{II}: M : N
3 : 10: 10: 5 : 1.5
0.16
0.36
0.515
$(0.16\gamma)(0.36\gamma)$

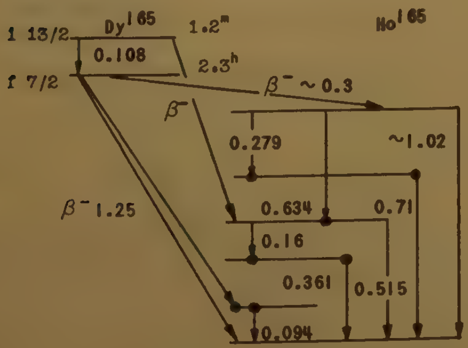
W.C.Jordan, J.M.Cork, S.B.Burson, Phys. Rev. 92, 1218 (1953); 91, 497A(1953).

Dy^{165} 66 99 2.32^h
τ_2 2.4^h Dy(slow n)
γ 0.0927 K/LM = 2.7 sl ce^-

G.Weber, Z.Naturf. 9A, 115 (1954).

γ 0.0944 scin, $s\pi$ ce^- ppl
K : L : M
60: 7.8: 1.5
0.279 K/L > 5
0.361 K/L > 5
0.634
0.71
~1.02
$(\sim 1.2\beta)(0.094\gamma)$ $(\sim 0.3\beta)$ (all other γ's)
$(0.28\gamma)(0.71\gamma)$ $(0.63\gamma)(0.36\gamma)$ No other $\gamma\gamma$

W.C.Jordan, J.M.Cork, S.B.Burson, Phys. Rev. 92, 1218 (1953); 91, 497A(1953).



W.C.Jordan, J.M.Cork, S.B.Burson, Phys. Rev. 92, 1218 (1953).

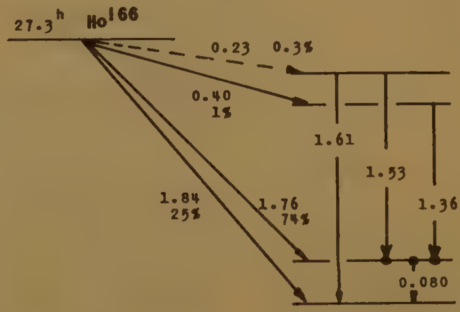
Ho^{161} 67 94 2.5^h
τ 2.5^h d 3.6^hEr chem
Er(24-Mev p), Dy(p)
γ 0.090 scin
w 0.17
x K x ray
No 0.511 γ

T.H.Handley, E.L.Olson, Phys. Rev. 93,524 (1954).

Ho^{163} 67 96 ?
τ <30^m or >1^y d 75^{m}Er chem
No 5^d activity (<0.01% 4.6^hHo) Dy(24-Mev p)

T.H.Handley, E.L.Olson, Phys. Rev. 92,1260 (1953).

Ho^{166} 67 99 27.3^h
β^- ~0.3% (0.23)
1% (0.40)
74% (1.76) $\beta\gamma$
25% (1.84)
γ 85† 0.080 $\alpha_K = 1.9$ K/L = 0.25 scin
10† 1.36
2† 1.53
~1† 1.61
$(0.080\gamma)(1.36\gamma, 1.53\gamma)$
No 0.170γ (<0.9†) No 1.44γ (<2†)



A.W.Sunyar, Phys. Rev. 93, 1345 (1954).

Resonances Ho^{165}(n) E_n = 0.1 to 30 ev
3.96 $\sigma_0\Gamma^2 \sim 77$ cryst s
12.8 $\sigma_0\Gamma^2 \sim 300$
19
22
39

H.L.Foote, Jr., H.H.Landon, V.L.Sailor, Phys. Rev. 92, 656(1953); 90,362A(1953).

Er^{160} 68 92 30^h
τ 30^h Ta^{181}(350-Mev p) ms

M.C.Michel, D.H.Templeton, Phys. Rev. 93,1422 (1954).

Er^{161} 68 93 3.6^h
τ 3.5^h Ta^{181}(350-Mev p) ms

M.C.Michel, D.H.Templeton, Phys. Rev. 93,1422 (1954).

Er^{161} 68 93 3.6^h
τ 3.6^h Er (17-Mev p) chem
Not by Ho(p), Er(n,γ)
γ 0.065 scin
0.195?
0.824
1.120
No 0.511 γ

T.H.Handley, E.L.Olson, Phys. Rev. 93, 524 (1954).

Er^{163} 68 95 75^m
τ 75^m Ho^{165} (19-Mev p) chem
γ 0.43 scin
1.10
No β^+ (<1%)
τ of daughter <30^m or >1^y chem
Mass assignment from 19-Mev threshold

T.H.Handley, E.L.Olson, Phys. Rev. 92,1260 (1953).

Tm^{165} 69 96 24.5^h
τ 29^h Ta^{181} (350-Mev p) ms

M.C.Michel, D.H.Templeton, Phys. Rev. 93,1422 (1954).

τ 24.5^h Er (>12-Mev p) chem
p 9.9^hEr chem
γ 0.205 scin
0.808
1.16
1.38
No β^+ (< 1%)

T.H.Handley, E.L.Olson, Phys. Rev. 92,1260 (1953).

Tm^{166} 69 97 7.7^h
τ 7.7^h ms

M.C.Michel, D.H.Templeton, Phys. Rev. 93,1422 (1954).

Tm^{167} 69 98 9.6^d
τ 9.6^d ms

M.C.Michel, D.H.Templeton, Phys. Rev. 93,1422 (1954).

Tm^{170} 69 101 127^d
Resonances Tm^{169}(n) E_n = 0.1 to 30 ev
3.92 ev $\sigma_o\Gamma^2 \sim 380$ cryst s
14.8
17.6

M.L.Foote, Jr., M.H.Landon, V.L.Sailor, Phys. Rev. 92, 656(1953); 90,362A(1953).

Yb
Yb (α,$\alpha'\gamma$) E_α = 3.0
γ 0.082 scin

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93,351 (1954).

Yb^{166} 70 96 58^h
τ 58^h ms

M.C.Michel, D.H.Templeton, Phys. Rev. 93,1422 (1954).

Yb^{169} 70 99 31.8^d
τ 32^d ms

M.C.Michel, D.H.Templeton, Phys. Rev. 93,1422 (1954).

Lu Resonances Lu(n) E_n = 0.03 to 35ev cryst s

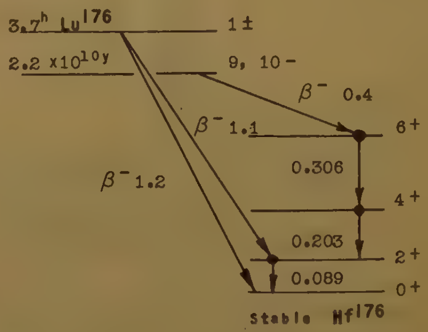
E_o(ev)	$\sigma_o\Gamma^2$
0.142	1.4
1.57	0.9
2.62	6
4.80	21
5.30	45
11.4	58
14.4	(560)*
20.6	
24	
31	

*2 or more unresolved resonances

Lu (α,$\alpha'\gamma$) E_α = 3.0
γ 0.077 scin
0.113
0.184?

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 93,906 (1954).

Lu^{176} 71 105 2.2×10^{10y}
τ_2 2.15×10^{10y} 289 γ's/sec/g Lu
γ 0.6† 0.089 scin
3.3† 0.203
3.7† 0.306
ϵ/β^- < 0.1 assuming x rays from conversion of E2 γ's



J.A.Arnold, Phys. Rev. 93, 743 (1954).

Hf Hf (α,$\alpha'\gamma$) E_α = 3.0
γ 0.093 scin
0.112

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 93,906 (1954).

Hf^{171} 72 99 16^h
γ 0.63* Yb (56-Mev α) chem
1.02* scin
*Could belong to $23.6^h Hf^{173}$

A.H.Wapstra, C.Jongejans, Physica 20,36(1954).

Hf^{173} 72 101 23.6^h

			Yb(58-Mev α)	chem scin
γ	100†	0.121		
	75†	0.299		
	w	0.63*		
	w	1.02*		
x	90†	K x ray		

*Could belong to $16^h Hf^{171}$

A.H.Wapstra, C.Jongejans, Physica 20,36(1954).

Hf^{175} 72 103 70^d

γ 0.0895 K : L : M = 30 : 15 : 1.5
0.340 K : L : M = 100 : 20 : 5
Hf(slow n)

A.A.Bashilov, N.M.Anton'eva, B.S.Dzhelepov, A.I.Dolgentseva, Izvest. Akad. Nauk Ser. Fiz. SSSR 17, 437(1953); Chem. Abstr. 48-2489h(1954).

Hf^{178} 72 106 stable

Resonances Hf^{177}(n) chopper

E_o (ev)	$\sigma_o\Gamma^2$	σ_o	Γ
1.02	110	~55.000	~0.045
2.34	280	>30,000	<0.10
5.7	52	> 2,400	<0.15
6.5	80	> 7,200	<0.11
8.8	55	> 3,600	<0.12
13.6	28	> 450	<0.25

Capture γ's per pile n capture = 4.1

L.M.Bollinger, S.P.Harris, C.T.Hibdon, C.O. Muehlhause, Phys. Rev. 92,1527(1953); 87,222A (1952).

Hf^{179} 72 107 stable

Resonance Hf^{178}(n) chopper
7.6 ev $\sigma_o\Gamma^2 \sim 1400$ $\Gamma < 0.26$
Capture γ's per pile n capture = 3.5

L.M.Bollinger, S.P.Harris, C.T.Hibdon, C.O. Muehlhause, Phys. Rev. 92,1527(1953); 87, 222A(1952).

Hf^{180} 72 108 5.5^h

			sγ ce⁻
γ	0.0576	M3	
	0.0933	E2	
	0.2155	E2 $\tau < 10^{-6}$s	
	0.3330	E2 $\tau < 10^{-6}$s	
	0.4435	E2 $\tau < 10^{-6}$s	

(0.444γ)(0.333γ)(θ)
(0.444γ)(0.216γ)(θ) ΔI = 2 for each γ

J.W.Mihelich, G.Scharff-Goldhaber, M.McKeown, Phys. Rev. 94, 794A (1954); verbal report.

Hf^{180} 72 118 stable

Resonance Hf^{179}(n) chopper
5.6 ev $\sigma_o\Gamma^2 \sim 25$ $\Gamma < 0.1$

L.M.Bollinger, S.P.Harris, C.T.Hibdon, C.O. Muehlhause, Phys. Rev. 92,1527(1953); 87, 222A(1952).

Hf^{181} 72 109 46^d

τ 46^d u
γ (0.133) $\tau = 18.6^{\mu s}$ 5 βγ

H.S.Murdoch, Proc. Phys. Soc. 66A, 944(1953).

Hf^{181} 72 109 46^d

β^- 0.405 Hf(slow n) s

		K : L_2 : L_3 : MN*
γ	0.1322	21 : 16 : 14 : 10
	0.1352	12
	0.478	1.9 : 0.4 : 0.1
	0.607	0.04 : ~ 0.006

*ce⁻ per 100 β's

A.A.Bashilov, N.M.Anton'eva, B.S.Dzhelepov, A.I.Dolgentseva, Izvest. Akad. Nauk Ser. Fiz. SSSR 17, 437 (1953); Chem. Abstr. 48-2489h(1954).

Hf^{180}(pile n) γce⁻ scin x/γ

		α_k	
γ	0.132	0.48	E2
	0.135	1.9	M1
	0.345	0.08	
	0.480	0.034	M1,E2 or E1,M2

K/LM = 4

F.K.McGowan, Phys. Rev. 93, 163 (1954).

		E2	M1	
γ	(0.132)	100%		γγ(θ)
	(0.135)	20%	80%	
	(0.345)	50%	50%	
	(0.480)	60%	40%	

(0.132γ)(0.480γ)(θ) I = 5/2, 9/2, 7/2
(0.345γ)(0.135γ)(θ) I = 9/2, 9/2, 7/2

F.K.McGowan, Phys. Rev. 93, 471 (1954).

Ta^{181} 73 108 stable

γ Ta^{181}(p,p'γ) E_p = 2.0 s ce⁻
0.137 *1*
0.166 *1*

T.Huus, J.H.Bjerregaard, Phys. Rev. 92,1579, (1953).

γ Ta^{181}(p,p'γ) E_p = 4 scin
(0.137) I = 9/2 p,γ(θ)
(0.303) I = 11/2 p,γ(θ)

W.J.Goldburg, R.M.Williamson, Phys. Rev. 94, 747A(1954); verbal report.

γ Ta^{181}(p,p'γ) E_p = 3 scin

100†	0.139	I = 9/2	p,γ(θ)
100†	0.167		
80†	0.309	I = 11/2	p,γ(θ)

J.T.Eisinger, C.F.Cook, C.M.Class, Phys. Rev. 94, 735,747A(1954).

Ta^{181}(α,α'γ) E_α = 3.0
γ 0.137 scin

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93,351 (1954).

Ta^{182} 73 109 111^d

γ	(0.100)	$\tau = 1.3\times10^{-9s}$	$\gamma(ce^-)$
	(1.29)	$\tau = 1.0\times10^{-9s}$	$\beta\gamma$

A.W.Sunyar, Phys. Rev. 93, 1122 (1954).

Resonances Ta^{181}(n) E_n = 0.3 to 50ev crystal s

E_o(ev)	$\sigma_o\Gamma^2$
4.29	59
10.36	32
13.9	12
20.7	7
24.2	27
36.7	~250
39.4	~180

R.L.Christensen, Phys. Rev. 92,1509(1953).

Resonances Ta^{181}(n) E_n = 5 to 5000ev time of flight

E_o(ev)	$\sigma_o\Gamma^2$
4.1	55.4
6.1?	
10.2	48
13.7	11
20.0	10.3
24.0	39
35.1	200
38.2	280

E.Melkonian, W.W.Havens, Jr., L.J.Rainwater, Phys. Rev. 92, 702(1953).

Capture γ's Ta^{181}(n,γ)) s pr

1 †	4.84	0.3†	5.57
0.5†	5.05	0.3†	5.78
0.5†	5.21	0.7†	6.07
0.3†	5.38		

Also graph E_γ = 2.5 to 8.0

$B_n(Ta^{181})$ = 6.0 from Ta^{181}(d,p)

†Photons per 100 n captures

G.A.Bartholomew, B.B.Kinsey, Can. J. Phys. 31, 1025 (1953).

Ta^{183} 73 110 5^d

τ 5.2^d $Ta^{181}(n,\gamma)(n,\gamma)$

β^- 0.56 s

γ cryst

	0.046481	5			
	0.052593	5	18†	0.16234	3
w	0.083	1	6	0.19269	7
14†	0.09907	1	18†	0.20506	5
24†	0.10793	1	19†	0.20982	4
4†	0.10973	1	w	0.236	1
1†	0.1104	2	30†	0.24426	4
4†	0.14377	5	100†	0.24605	3
27†	0.14415	5	25†	0.29171	6
11†	0.16053	3	26†	0.31308	7
33†	0.16146	3	39†	0.35404	9

J.W.M.DuMond, H.C.Hoyt, P.E.Marmier, J.J. Murray, Phys. Rev. 92, 202 (1953).

W

Capture γ's W(n,γ) s pr

2.4†	4.67	0.3†	6.02?
0.6†	4.94	3.8†	6.182*
2.3†	5.14	0.3†	6.40
3.4†	5.245	0.1†	6.73
2.4†	5.304	0.3†	7.42**
0.3†	5.77		

Also graph E_γ = 3 to 7.5

$*W^{183}$? $**W^{184}$?

W(γ,n) thresholds known at 6.3 and 7.2

†Photons per 100 n captures

B.B.Kinsey, G.A.Bartholomew, Can. J. Phys. 31, 1051 (1953).

W^{181} 74 107 140^d

γ 0.1365 K/L ~8 W^{180}(pile n)

0.1525 K/L ~8 sπ ce^-

$\gamma\gamma$?

No other γ (< 10^{-6} of K x rays) scin

J.M.Cork, W.H.Nester, J.M.LeBlanc, M.K.Brice, Phys. Rev. 92, 119 (1953).

W^{182} 74 108 stable

γ $W^{182}(p,p'\gamma)$ E_p = 2.5

0.101 scin

C.L.McClelland, H. Mark, C.Goodman, Phys. Rev. 93, 904 (1954).

γ W(p,p'γ) E_p = 1.75

0.102 s ce^-

T.Huus, J.H.Bjerregaard, Phys. Rev. 92,1579, (1953).

W^{183} 74 109 stable

γ $W^{183}(p,p'\gamma)$ E_p = 2.5

0.103 scin

C.L.McClelland, H.Mark, C.Goodman, Phys. Rev. 93, 904 (1954).

W^{184} 74 110 stable

γ $W^{184}(p,p'\gamma)$ E_p = 2.5

0.112 scin

C.L.McClelland, H.Mark, C.Goodman, Phys. Rev. 93, 904 (1954).

γ W(p,p'γ) E_p = 1.75

0.113 s ce^-

T.Huus, J.H.Bjerregaard, Phys. Rev. 92,1579, (1953).

W^{186} 74 112 stable

γ $W^{186}(p,p'\gamma)$ E_p = 2.5

0.124 scin

C.L.McClelland, H.Mark, C.Goodman, Phys. Rev. 93, 904 (1954).

γ W(p,p'γ) E_p = 1.75

0.124 s ce^-

T.Huus, J.H.Bjerregaard, Phys. Rev. 92,1579, (1953).

W^{187} 74 113 23.9^h

(0.480γ) (0.072γ, 0.134γ, 0.206γ) (0.134γ) (0.072γ, 0.480γ) scin

E. Germagnoli, A. Malvicini, L. Zappa, Nuovo Cim. 10, 1388 (1953).

Re

Resonances Re (n) E_n = 0.003 to 10^4 ev time of flight

E_o (ev)		
2.18*	σ_o = 5700	Γ = 0.09
4.40**	σ_o = 2000	Γ = 0.05
	$\sigma_o\Gamma^2$	
5.92	2.88	
7.18	15.0	
11.3**	29.6	
13.1	19.0	
17.7	44.7	
21.1	19.4	

*Re^{185} **Re^{187}

E. Melkonian, W. W. Havens, Jr., L. J. Rainwater, Phys. Rev. 92, 702 (1953).

Re (α, α'γ) $E_α$ = 3.0

γ 0.130 scin

N. P. Heydenburg, G. M. Temmer, Phys. Rev. 93, 906 (1954).

Re^{186} 75 111 3.8^d

β⁻ 27% ~0.9 s
73% 1.06

γ 0.081 s ce⁻
0.1234
0.1383 K : L : M = 0.9 : 3 : 1
0.164?

N. M. Anton'eva, A. A. Bashilov, B. S. Dzhelepov, L. S. Chervinskaya, Izvest. Akad. Nauk Ser. Fiz. SSSR 17, 507 (1953); Chem. Abstr. 48-2490b (1954).

$Re^{189?}$ 75 114 9.8^m

τ 9.8ᵐ Os (26-Mev n) chem
β⁻ 1.8 a

A. H. W. Aten, Jr., G. D. de Feyfer, Physica 19, 1143 (1953).

Os

Os (α, α'γ) $E_α$ = 3.0

γ 0.157 scin
0.180
0.188
0.202

N. P. Heydenburg, G. M. Temmer, Phys. Rev. 93, 906 (1954).

Os^{191} 76 115 15^d

γ Os (pile n) scin
0.129 α_K = 2.1 M1 + E2 x/γ
No β(0.129γ), no β(ce⁻ 0.129γ)

F. K. McGowan, Phys. Rev. 93, 163 (1954).

Os^{193} 76 117 31^h

β⁻ w 0.6 β(ce⁻) scin
w 0.82
w 0.96
w 1.03
1.10 scin

γ (0.073) $\tau = 6.0\times10^{-9s}$ sl ce⁻
(0.139) $\tau < 2\times10^{-9s}$ sl β(ce⁻)
(0.251)?
(0.281) $\tau < 2\times10^{-9s}$
(0.321)
(0.460)
(0.558)?

No 0.106γ No 0.328γ

H. de Waard, Physica 20, 41 (1954).

Ir

Ir (α, α'γ) $E_α$ = 3.0

γ 0.129 scin

N. P. Heydenburg, G. M. Temmer, Phys. Rev. 93, 906 (1954).

Ir^{191} 77 114 stable

I 3/2 s
μ +0.2
Q +1.5

W. von Siemens, Ann. Physik 13, 136 (1953).

Ir^{192} 77 115 1.4^m

τ_1 1.45ᵐ Ir (slow n)

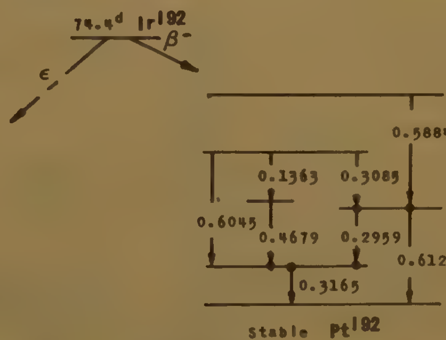
G. Weber, Z. Naturf. 9A, 115 (1954).

β⁻ ~0.1% Ir (slow n); a
γ IT 99.9% 0.056 α ≥ 1000 s ce⁻
No continuous ce⁻ (< 3%) a
No continuous γ (< 0.1%) a

G. Weber, A. Flammersfeld, Z. Naturf. 8a, 580, (1953).

Ir^{192} 77 115 74.4^d

(0.296γ)(0.309γ)(0.317γ) 4π scin
(0.468γ)(0.317γ)
(0.588γ)(0.613γ)



D. C. Lu, M. L. Wiedenbeck, Phys. Rev. 94, 501 (1954).

Ir^{193} 77 116 stable

I	3/2		s
μ	+0.2		
Q	+1.5		

W. von Siemens, Ann. Physik 13,136(1953).

Ir^{194} 77 117 7.3^s

τ_1	7.3^s		Pt($\leq$48-Mev n) Ir($\sim$15-Mev n)
γ	0.125	$a_K \sim 1.5$	scin
	5.6		

F.D.S.Butement, A.J.Poë, Phil. Mag. 45,31(1954)

Ir^{194} 77 117 19^h

γ	100†	0.32	scin
	22†	0.61	
	10†	1.18	
	5†	1.45	Pt($\leq$28-Mev γ); Ir(pile n)
	1.2†	$\sim$1.8	Pt(48-Mev n) chem

F.D.S.Butement, A.J.Poë, Phil. Mag. 45, 31 (1954).

Ir^{195} 77 118 2.3^h

τ	2.3^h	Pt(48-Mev n) chem Pt($\leq$28-Mev γ)
β^-	1.2	$a\beta\gamma$
	2.1	a
γ	0.42	scin
	0.66	
	0.80	
	>1.0	

(1.2β)(γ); no (2.1β)(γ)
$a\beta\gamma$ indicates another lower energy β

F.D.S.Butement, A.J.Poë, Phil. Mag. 45,31 (1954).

$Ir^{196?}$ 77 119 9.7^d

τ	9.7^d	Pt(48-Mev n) chem not Pt($\leq$28-Mev γ)
β^-	0.08	a
γ	0.58	scin
	0.76	probably double
	$\sim$1	

F.D.S.Butement, A.J.Poë, Phil. Mag. 45,31 (1954).

Ir^{197} 77 120 7^m

τ	7^m	Pt($\leq$28-Mev γ) chem not Pt(48-Mev n)
β^-	<1.6	
	1.6	a
γ	1.8	scin
(1.6β)$\gamma\gamma$		$a\beta\gamma$

F.D.S.Butement, A.J.Poë, Phil. Mag. 45, 31 (1954).

Ir^{198} 77 121 50^s

τ	50^s	Pt(48-Mev n) not Pt($\leq$28-Mev γ)
β^-	3.6	a
γ	0.78	scin
(3.6β^-)(0.78γ)		$a\beta\gamma$

Assignment supported by large E_{dis}

F.D.S.Butement, A.J.Poë, Phil. Mag. 45, 31 (1954).

Pt

Capture γ's		Pt(n,γ)	s pr
	1.8†	5.24	
	1.1†	6.07	
	0.2†	7.26	
	0.3†	7.92	

Also graph E_γ = 3 to 8
$B_n(Pt^{194?}) = 6.1$; $B_n(Pt^{195?}) = 8.1$
Both values from Pt(γ,n) and Pt(d,p)
†Photons per 100 n captures

B.B.Kinsey, G.A.Bartholomew, Can. J. Phys. 31, 1051 (1953).

Pt^{188} 78 110 10.5^d

τ	10.5^d	p 42^hIr chem Ir(50-Mev p) chem
γ	0.192*	sπ ce$^-$
ce$^-$	0.043*	
	0.053*	
x	K x ray*	crit a

R.A.Naumann, Phys. Rev. 94, 794A(1954); * verbal report.

Pt^{191} 78 113 3.0^d

γ	0.042	0.220 sπ/2 ce$^-$
	0.082	0.268
	0.096	0.350
	0.1296*	0.360
	0.158 ?	0.409
	0.172	0.456
	0.179	0.540
	0.188*	0.62

No 0.125 γ* Ir(d)

E.P.Tomlinson, R.A.Naumann, J.W.Mihelich, Phys. Rev. 94, 794A(1954); * verbal report.

γ	0.0825	$L_1:L_2:L_3$ = 10:18:16	
	0.0965	L_1/L_2 = 5	sπ ce$^-$
	0.1294	L_1/L_2 = 3	d$\sim 4^h$Au

L.P.Gillon, K.Gopalakrishnan, A.de-Shalit, J.W.Mihelich, Phys. Rev. 93, 124 (1954).

$Pt^{194?}$ 78 116 stable

	Pt(p,p'γ)	E_p = 3.0
γ	0.212	scin
	0.240 ?	
	0.333	

C.M.Class, C.F.Cook, J.T.Eisinger, Phys. Rev. 94, 744, 747A (1954).

	Pt(a,a'γ)	E_a = 3.0
γ	0.213	scin
	0.328	

W.P.Heydenburg, G.M.Temmer, Phys. Rev. 93,906 (1954).

Pt^{195} 78 117 stable

	Pt(a,a'γ)	E_a = 3.0
γ	0.029	scin
	0.098	
	0.128	

W.P.Heydenburg, G.M.Temmer, Phys. Rev. 93,906 (1954).

Au^{191} 79 112 $\sim 4^h$

τ $\sim 4^h$ d 57^mHg
γ 0.0480 sn ce$^-$
0.0910 $L_2/L_3 = 1.2$
0.130
0.1587

L.P.Gillon, K.Gopalakrishnan, A. de-Shalit, J.W.Mihelich, Phys. Rev. 93, 124 (1954).

Au^{191-3} 79 2^s

τ 2.0^s Hg(p); Tl(p)
No γ scin
Mass assignment from thresholds (values not stated)

A.Henrikson, S.W.Breckon, J.S.Foster, Proc. Roy. Soc. Canada 47, 127A (1953).

Au^{192} 79 113 4.8^h

τ	4.8^h	Au(p); Hg(p)	chem
γ	0.137	0.402	s
	0.158	0.415	ce$^-$ (Pt)
	0.168	0.437	
	0.188	0.467	
	0.205	0.588	
	0.282	0.612	
	0.296	0.765	
	0.316	1.135	

G.T.Ewan, A.L.Thompson, Proc. Roy. Soc. Canada 47, 126A (1953).

γ 20† 0.2958 d 5.7^hHg sn ce$^-$
40† 0.3168
†Relative intensity of ce$^-$

L.P.Gillon, K.Gopalakrishnan, A. de-Shalit, J.W.Mihelich, Phys. Rev. 93, 124 (1954).

Au^{193} 79 114 $<1^h$

τ_1 $<1^h$ d 12^hHg
γ 0.0319 $L_2/L_3 = 0.65$ E3 sn
0.2181* $K:L_2:L_3 = 13:8:8$
100† 0.2579 K/L = 5.4 M4
<3† 0.2906
*Not placed in decay scheme. See Hg^{193}

L.P.Gillon, K.Gopalakrishnan, A. de-Shalit, J.W.Mihelich, Phys. Rev. 93,124(1954); 89, 908A(1953).

Au^{193} 79 114 17.4^h

τ_2	17.4^h	Au(p); Hg(p)	chem
γ	0.0997	0.2551	s
	0.1123	0.2679	ce$^-$(Pt)
	0.1555	0.3164	
	0.1733	0.4396	
	0.1859		

G.T.Ewan, A.L.Thompson, Proc. Roy. Soc. Canada 47, 126A (1953).

γ 0.1124 sn ce$^-$
0.1735 d 12^hHg, d 4^hHg
0.1862

L.P.Gillon, K.Gopalakrishnan, A. de-Shalit, J.W.Mihelich, Phys. Rev. 93, 124 (1954).

Au^{195} 79 116 30^s

γ 0.0569 $a \sim \infty$ E3
$L_2/L_3 = 1.05$
0.2615 $a_K = 0.25$ M1 + E2
K : L : M = 100 : 18 : 5.3
0.318
d 40^hHg, not d 9.5^hHg

O.Huber, J.Halter, R.Joly, D.Maeder, J. Brunner, Helv. Phys. Acta 26, 591A (1953).

γ 0.0565 $L_2/L_3 = 1$ E3 sn ce$^-$
$M_2/M_3 = 1$
L/M = 1.6
0.2616 $K/L_1 = 5.5$ M1
d 40^hHg, not d 9.5^hHg

L.P.Gillon, K.Gopalakrishnan, A. de-Shalit, J.W.Mihelich, Phys. Rev. 93, 124 (1954); 89, 908A(1953).

Au^{195} 79 116 185^d

γ 0.0308 $L_1/M = 3$ M1 sn ce$^-$
0.0988 $K/L \geq 4$ M1
$L_1 : L_2 : L_3 = 70 : 10 : 3$
d 9.5^hHg

L.P.Gillon, K.Gopalakrishnan, A. de-Shalit, J.W.Mihelich, Phys. Rev. 93, 124 (1954).

Au^{197} 79 118 7.4^s

γ 0.130 d 23^hHg, Au(n,n'), scin
0.277 K : L : M = 100 : 19 : 4.7
$a_K = 0.29$ M1 + E2
0.407 K/LM = 2.3
$a \sim \infty$ M4 crossover

O.Huber, J.Halter, R.Joly, D.Maeder, J. Brunner, Helv. phys. Acta 26, 591A (1953).

Au^{197} 79 118 stable

Au(α,$\alpha'\gamma$) $E_\alpha = 3.0$
γ 0.077 scin
0.190
0.277

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 93, 906 (1954).

Au^{197}(p,p'γ) $E_p = 2$ to 4
γ 0.195 ? scin
0.277 I = 5/2 p,$\gamma(\theta)$
0.545 I = 7/2

W.I.Goldburg, R.M.Williamson, Phys. Rev. 94, 747A(1954); verbal report.

Au(n,n')7.4^sAu $E_n = 0.4$ to 5
Threshold 0.42
Levels* 1.2 scin
⋮
*Slight increases in slope of σ curve

M.C.Martin, B.C.Diven, R.F.Taschek, Phys.Rev. 93,199(1954); 92,1096A(1953).

Au^{197} 79 118 stable

		$Au(n,n')7.4^{s}Au$ $E_n = 0.53$ to 2.0	
Threshold	0.53		
Levels*	1.14		scin
	1.44		

*Sharp increases in slope of σ curve

A.A.Ebel, C.Goodman, Phys. Rev. 93, 197(1954).

μ	0.14	s
Q	+0.56	

W. v. Siemens, Ann. Physik 13, 158 (1953).

Au^{198} 79 119 2.69^{d}

β^-	0.025%	1.371	$\Delta I = 3$, yes		sl
γ	0.82%	0.6765	$\alpha_K = 0.022$ K/L = 5.7	M1 32%	
	0.16%	1.0889	$\alpha_K = 0.0045$ K/L = 6.3	E2 100%	

L.G.Elliott, M.A.Preston, J.L.Wolfson, Can. J. Phys. 32, 153 (1954).

γ	100 †	(0.41)
	1.3 †	(0.68)
	0.25†	(1.09)

D.Maeder, R.Müller, V.Wintersteiger, Helv. Phys. Acta 27, 3 (1954).

γ (0.68) E2 60% M1 40% $\gamma\gamma(\theta)$

$(0.68\gamma)(0.41\gamma)(\theta)$ I = 2, 2, 0

C.D.Schrader, Phys. Rev. 92,928 (1953).

Resonance $Au^{197}(n)$ cryst s

4.91ev $\sigma_0 = 31{,}000^*$ $\Gamma = 0.18^*$

$\sigma_0\Gamma^2 = 732^{**}$

*From peak of resonance

**From wings of resonance

H.H.Landon, V.L.Sailor, Phys. Rev. 93, 1030 (1954).

Capture γ's $Au^{197}(n,\gamma)$ s pr

3 †	4.59	1.8†	6.15
1.7†	5.20	6 †	6.249
1.3†	5.52	2.8†	6.310
1.6†	5.70	2.1†	6.45
1.8†	5.97	1.5†	6.495*

Also graph $E_\gamma = 3.5$ to 7.8

$B_n?(Au^{197}) = 6.4$ from $Au^{197}(d,p)$

*Probably not Au^{198} g.s. γ which would be M2

†Photons per 100 n captures

G.A.Bartholomew, B.B.Kinsey, Can. J. Phys. 31, 1025 (1953).

Hg

		$Hg(\alpha,\alpha'\gamma)$ $E_\alpha = 3.0$	
γ	0.163		scin

H.P.Heydenburg, G.M.Temmer, Phys. Rev. 93,906 (1954).

$Hg^{<191}$ 80 <111 25^{m}

τ	$\sim 25^{m}$		Au(>65-Mev p) chem
	0.0286	$L_1/M_1 \sim 2$; $L_1:L_2:L_3 = 3:1:1$	$ce^-(Au)$

L.P.Gillon, K.Gopalakrishnan, A. de-Shalit, J.W.Mihelich, Phys. Rev. 93, 124 (1954).

$Hg^{\leq 191}$ 80 ≤111 90^{m}

τ	90^{m}	Au(65-Mev p) chem
Weak ce^-		sπ ce^-

L.P.Gillon, K.Gopalakrishnan, A. de-Shalit, J.W.Mihelich, Phys. Rev. 93, 124 (1954).

$Hg^{\leq 191}$ 80 ≤111 $\sim 3^{h}$

τ	$\sim 3^{h}$	Au(65-Mev p) chem
ce^-	0.08802	sπ ce^-

ce^- shows no growth

L.P.Gillon, K.Gopalakrishnan, A. de-Shalit, J.W.Mihelich, Phys. Rev. 93, 124 (1954).

Hg^{191} 80 111 57^{m}

τ	57^{m}		Au(60-Mev p) chem
γ	0.2526		sπ ce^-
	0.2741		
e^-	0.0111	e_A or ce^-_M 0.0139γ	

L.P.Gillon , K.Gopalakrishnan, A. de-Shalit, J.W.Mihelich, Phys. Rev. 93, 124 (1954).

Hg^{192} 80 112 5.7^{h}

γ	0.0313	$L_1:L_2:L_3 = 47:10:10$	M1(E1?) sπ ce^-
	0.1143	$K/L_1 = 5$ M1	
	0.1423	$K/L_1 = 3$	
	0.1460	$K/L_1 = 5$ M1	
	0.1574	$K/L_1 = 3.5$	
	0.275		Au(45-Mev p) chem

L.P.Gillon, K.Gopalakrishnan, A. de-Shalit, J.W.Mihelich, Phys. Rev. 93, 124 (1954).

Hg^{193} 80 113 12^{h}

γ	0.0392	L_1ce^- only M1	sπce$^-$
	0.1012	$L_1/L_3 = 0.27$ M4	
	0.342*	$K/L_1 = 8$	

p < 1^{h}Au 84% p 4^{h}Hg 16%

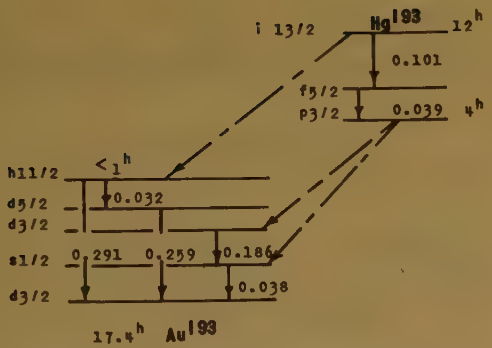
*Not placed in decay scheme

27^{h} activity not found for Hg^{193}

Hg^{193} 80 113 4^{h}

γ	0.0379	L/M = 5.3 M1 + E2; $L_1:L_2:L_3 = 30:65:40$	sπce$^-$
	0.1865		Au(35-Mev p) chem

Hg^{193}
80 113



L.P.Gillon, K.Gopalakrishnan, A. de-Shalit, J.W.Mihelich, Phys. Rev. 93, 124 (1954).

Hg^{194}
80 114
0.4^s

τ_1 0.40^s Au(p); Hg(p)
γ 0.048 scin
0.134 M3 or E3 from τ
Mass assignment from thresholds (values not stated)

A.Henrikson, S.W.Breckon, J.S.Foster, Proc. Roy. Soc. Canada 47, 127A (1953).

Hg^{195}
80 115
40^h

τ_1 40^h
γ 0.0371 $\alpha \sim \infty$ $L_1/L_2 = {\sim}10$
L : M : N = 100 : 33 : 18
0.1227 $\alpha \sim 200$ $L_2/L_3 = {\sim}0.3$
K : L : M = 100 : 442 : 20
0.559 $\alpha_K = 0.028$
K : L : M = 100 : 19 : 4.6
p 9.5^hHg 50% p 30^sAu 50%

O.Huber, J.Halter, R.Joly, D.Maeder, J.Brunner Helv. Phys. Acta 26, 591A (1953).

γ 0.037 Au(35-Mev p)
0.056 sp ce$^-$
0.122 ce$^-$ (Hg)
0.130?
0.206
0.261
0.318
0.558

D.G.Douglas, A.L.Thompson, Proc. Roy. Soc. Canada 45, 173A (1951).

γ 0.0369 M1 sp ce$^-$
$L_1 : L_2 : L_3 = 10 : 2 : {\sim}0$
0.1226 K/L = 0.2 M4
$L_1 : L_2 : L_3 = 10 : 2 : 20$
L/M = 2
p 9.5^hHg 48% p 30^sAu 52% Au(25-Mev p) chem

L.P.Gillon, K.Gopalakrishnan, A. de-Shalit, J.W.Mihelich, Phys. Rev. 93, 124 (1954); 89, 908A (1953).

Hg^{195}
80 115
9.5^h

τ_2 9.5^h not p 30^sAu
γ 0.0614 $L_1L_2/L_3 = 1.8$
0.179
0.600
100† 0.779 $\alpha_K = 0.016$ K/LM = 4.3
40† 1.15

O.Huber, J.Halter, R.Joly, D.Maeder, J. Brunner, Helv. Phys. Acta 26, 591A (1953).

γ 0.061 Au(35-Mev p)
0.180 sp ce$^-$
0.600
0.780

D.G.Douglas, A.L.Thompson, Proc. Roy. Soc. Canada 45, 173A (1951).

γ 0.0612 M1 + E2 sp ce$^-$
$L_1 : L_2 : L_3 = 12 : 11 : 10$
0.1798 K/L > 4 M1
ce$^-$(0.0612γ)/ ce$^-$(0.1798γ) = 29
No 0.262γ (< 10%) Au(25-Mev p) chem

L.P.Gillon, K.Gopalakrishnan, A. de-Shalit, J.W.Mihelich, Phys. Rev. 93, 124 (1954).

Hg^{197}
80 117
65^h

γ 0.0776 $\alpha = 2.5$ d 25^hHg
$L_1L_2/L_3 = 5$
0.192 $\alpha_K = 0.9$ M1
K : L : M = 100 : 16 : 4.8

O.Huber, J.Halter, R.Joly, D.Maeder, J.Brunner, Helv. Phys. Acta 26, 591A (1953).

Hg^{198}
80 118
stable

Level Hg(γ,γ') $E_\gamma = 0.411$
(0.411) $\tau = 2.2 \times 10^{-11 s *}$
Source rotated to compensate for recoil
*With statistical weight factor of 5

W.G.Davey, P.B.Moon, Proc. Phys. Soc. 66A, 956 (1953).

Hg^{199}
80 119
stable

Level Hg(γ,γ') $E_\gamma = 0.209$
(0.209) $\tau = 3.1 \times 10^{-10 s}$
Source heated to compensate for recoil

F.R.Metzger, W.B.Todd, Phys. Rev. 94, 794A (1954); J. Franklin Inst. 257, 248 (1954).

Hg^{200}
80 120
stable

Capture γ's Hg(n,γ) s pr

2†	4.66	3†	5.39
4†	4.73	5†	5.65
3†	4.83	12†	5.959
1†	4.95	5†	6.446
3†	5.07	0.3†	6.6 ?
		0.3†	7.1 ?

Also graph E_γ = 2.5 to 7.5
†Photons per 100 captures in Hg

B.B.Kinsey, G.A.Bartholomew, Can. J. Phys. 31, 1051 (1953).

Hg^{201} 80 121 stable

Q 0.6 $HgCl_2$ quad res

H.G.Dehmelt, H.G.Robinson, W.Gordy, Phys. Rev. 93, 480 (1954); 93, 920A (1954).

Hg^{201} 80 121 ?

τ_1 $< 1^m$ or $> 10^m$ Hg^{204} ($\leq$ 20-Mev γ)

No γ activity (< 1% of expected M4 IT)

I.Bergström, R.D.Hill, G. de Pasquali, Phys. Rev. 92, 918 (1953).

Hg^{203} 80 123 ?

τ_1 $< 1^m$ or $> 10^m$ Hg^{204} ($\leq$ 20-Mev γ)

No γ activity (< 1% of expected M4 IT)

I.Bergström, R.D.Hill, G. de Pasquali, Phys. Rev. 92, 918 (1953).

Hg^{203} 80 123 47^d

β^- 0.22 Hg(pile n); sl

γ 0.279 $\alpha_K = 0.14$ K/LM = 2.57 sl ce^-

No 0.498 β (< 1.5%)

A.H.Wapstra, D.Maeder, G.J.Nijgh, L.Th.M.Ornstein, Physica 20, 169 (1954).

$Hg^?$

Unassigned ce^- Au(p) chem; $s\pi ce^-$

A = 190, 191	0.0488	0.0634	0.0846	
	0.0617	0.0738		
A = 191	0.0186	0.0690	0.1994	0.2511
	0.0270	0.1161	0.2054	
A = 192	0.0332	0.0440	0.0910	0.1819
	0.0393	0.0850	0.1238	
	0.0436	0.0904	0.1648	

L.P.Gillon, K.Gopalakrishnan, A. de-Shalit, J.W.Mihelich, Phys. Rev. 93, 124 (1954).

Tl

Tl($\alpha,\alpha'\gamma$) $E_\alpha = 3.0$

γ 0.220? scin

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93, 351 (1954).

Capture γ's Tl(n,γ) s pr

7†	4.72	4†	5.90
4†	4.91	8†	6.20
7†	5.25	4†	6.54
17†	5.63		

Also graph E_γ = 2.5 to 8

$B_n(Tl^{203*}) = 6.5$; $B_n(Tl^{205*}) = 6.2$ from Tl(d,p)

†Photons per 100 n captures

G.A.Bartholomew, B.B.Kinsey, Can. J. Phys. 31, 1025 (1953).

Tl^{197} 81 116 0.54^s

τ_1 0.54^s Hg(p); Tl(p)

γ 0.384 $\alpha = 2.7$ scin

Mass assignment from thresholds (values not stated)

A.Henrikson, S.W.Breckon, J.S.Foster, Proc. Roy. Soc. Canada 47, 127A (1953).

Tl^{198} 81 117 1.8^h

τ_1 1.75^h Au^{197}(40-Mev α); ms

M.C.Michel, D.H.Templeton, Phys. Rev. 93, 1422 (1954).

τ_1 1.9^h Hg(11-Mev d) chem

γ 0.0487 $s\pi$ ce^-

0.2607 K/L = 0.6 L_1/L_2 = 1.33 M4

0.2824 M1 + E2

(ce^-_K 0.261γ) / (ce^-_K 0.282γ) = 1.45

I.Bergström, R.D.Hill, G. de Pasquali, Phys. Rev. 92, 918, 849A (1953).

Tl^{198} 81 117 5.3^h

τ_2 5.3^h Au^{197}(40-Mev α); ms

M.C.Michel, D.H.Templeton, Phys. Rev. 93, 1422 (1954).

τ_2 5^h Hg(11-Mev d) chem

γ 0.195

0.284

0.402

0.411

0.675

(0.411γ) / (0.675γ) ~ 10

I.Bergström, R.D.Hill, G. de Pasquali, Phys. Rev. 92, 918, 849A (1953).

Tl^{199} 81 118 7.4^h

τ 7.4^h Au^{197}(40-Mev α); ms

M.C.Michel, D.H.Templeton, Phys. Rev. 93, 1422 (1954).

γ 0.0500 Hg(11-Mev d) chem $s\pi$ ce^-

0.1584

0.2081

0.2472 L_1/L_3 ~ 10 M1

0.3336

0.4546 No L_3 ce^- M1

0.4913 No L_3 ce^- M1

Not p 44^m Hg(0.367γ not observed)

I.Bergström, R.D.Hill, G. de Pasquali, Phys. Rev. 92, 918 (1953).

Tl^{200} 81 119 27^h

τ 27^h Au^{197}(40-Mev α); ms

M.C.Michel, D.H.Templeton, Phys. Rev. 93,1422 (1954).

γ Hg(11-Mev d) chem $s\pi$ ce^-

0.116*
0.252
0.289
0.3678 K/L = 2.0 L_1L_2/L_3 = 3.0
0.579
0.629
0.660*
0.786*
0.829

*Assignment doubtful

I.Bergström, R.D.Hill, G. de Pasquali, Phys. Rev. 92, 918 (1953).

Tl^{201} 81 120 3^d

γ

0.0305* M1 ? $s\pi$ ce^-
0.0321* M1 ?
0.1353 L_1/L_3 ~10 M1
0.1676 L_1/L_3 ~10 M1

No 0.21γ No 0.55γ

*Only L_1 ce^- observed Hg(11-Mev d) chem

I.Bergström, R.D.Hill, G. de Pasquali, Phys. Rev. 92, 918 (1953).

Tl^{202} 81 121 12^d

γ 0.4391 K/L = 2.6 $s\pi$ ce^-
L_1L_2/L_3 = 3.5 E2

No other γ Hg(11-Mev d) chem

I.Bergström, R.D.Hill, G. de Pasquali, Phys. Rev. 92, 918 (1953).

Tl^{206} 81 125 4.19^m

No long-lived activity found for Tl^{206} ms

M.C.Michel, D.H.Templeton, Phys. Rev. 93,1422 (1954).

Tl^{208} 81 127 3.1^m

β^- s
1.25*
1.6 *
1.8 *

γ ~6†* (0.277) scin, s ce^-
32† (0.511) E2 63% M1 37%

(0.511γ)(2.62γ)(θ) I(3.71 level) = 5

88† (0.583) α_K = 0.015 E2
$\tau = 2.4 \times 10^{-10}$s

(0.583γ)(2.62γ)(θ) I = 5, 3, 0

11† (0.860) E2 > 99.9%

(0.860γ)(2.62γ)(θ) I = 4, 3, 0

~0.6† (1.094)
100† (2.615) α_K = 0.0018 E3

L.G.Elliott, R.L.Graham, J.Walker, J.L.Wolfson, Phys. Rev. 93,356 (1954); 94,795A (1954); * verbal report.

Tl^{208} 81 127 3.1^m

$\Gamma(e_K^-$ 0.277 γ) ~60 ev $s\pi$

This is expected width of K electron level

H.Slätis, Arkiv Fysik 6, 415 (1953).

$Tl^?$

Unassigned ce^- Hg(11-Mev d) chem $s\pi$ ce^-

$\tau = 5^h$ to 27^h	0.0369	0.0376	0.1326	
$\tau = 6^h$?	0.458 0.465	0.473 0.480	0.503 0.508	0.513
$\tau = 27^h$?	0.0814 0.0829 0.0838	0.0997 0.1371 0.2260	0.2717 0.2935 0.2996	0.3038
τ = ?	0.1651 0.1887 0.1959 0.2015	0.3326 0.3336 0.3924 0.414	0.582 0.604 0.618 0.640	0.667 0.687

I.Bergström, R.D.Hill, G. de Pasquali, Phys. Rev. 92, 918 (1953).

Pb

Pb(n,n'γ) E_n = 3.9

γ scin
0.85
2.60

M.A.Rothman, C.E.Mandeville, Phys. Rev. 93, 796 (1954); 92, 1097A (1953).

Pb(p,p'γ) E_p = 3

No γ scin

C.M.Class, C.F.Cook, J.T.Eisinger, Phys. Rev. 94, 809A (1954).

Pb(α,α'γ) E_α = 3.0

No γ scin

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 93,906 (1954).

Pb^{201} 82 119 8.4^h

τ 8.4^h Tl(28-Mev d) chem

γ 100† 0.325 K/LM = 5 sl ce^-
33† 0.583

A.H.Wapstra, D.Maeder, G.J.Nijgh, L.Th.M.Ornstein, Physica 20, 169 (1954).

Pb^{202} 82 120 3.5^h

τ_1 3.5^h Tl(28-Mev d) chem

γ scin, sl ce

45† 0.123 E4
1.2† 0.322 E5
102† 0.416 E2
9† 0.455 M1
40† 0.657 E1
54† 0.784 E5
98† 0.957 E2

†Relative intensities of γ + ce^-

D.Maeder, A.H.Wapstra, Phys. Rev. 93, 1433 (1954).

Pb^{203} 82 121 52^h

γ 0.280 scin
3.6†* 0.403 $\alpha_K = 0.052$ E2 87%
$(0.403\gamma)(0.280\gamma)(\theta)$ I = 5/2, 3/2, 1/2
0.7†* 0.683

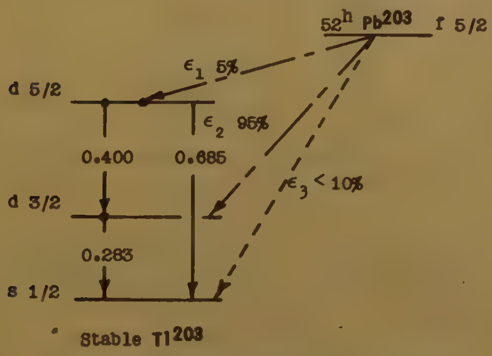
J.Verma, Phys. Rev. 94, 795A(1954); *verbal report; J.Franklin Inst. 257, 247(1954).

Tl(28-Mev d)chem; sl ce^-
γ 82.3† 0.279 K/LM = 2.55 L/MN = 3.5
3.8† 0.400 $\alpha_K = 0.12$
K/LM = 4.9 L/MN = 4.5
0.7† 0.678 $\alpha_K = 0.009$
$(0.400\gamma)(0.279\gamma)$ scin
$E_{dis} = 1.8 \pm 0.5$ from $\epsilon_K/\epsilon = 0.74 \pm 0.05$
based on $0.279\gamma/x_K$ in Hg^{203} and Pb^{203}

A.H.Wapstra, D.Maeder, G.J.Nijgh, L.Th.M.Ornstein, Physica 20, 169 (1954).

Tl(20-Mev d)chem;d 12^hBi chem
γ_1 100† 0.280 scin
γ_2 4.7† 0.400 $\tau \leq 10^{-7s}$
γ_3 0.87† 0.685
$\gamma_1\gamma_2$ $x_K\gamma_1$ $x_K\gamma_2$
$\gamma_1\gamma_2(\theta)$ consistent with I = 5/2, 3/2, 1/2
$\epsilon_1(K)/\epsilon_1(L) = 3$ $\epsilon_2(K)/\epsilon_2(L) = 7$
consistent with $E_{dis} = 1.4$
No ϵ_3 (< 10%)

J.R.Prescott, Proc. Phys. Soc. 67A, 254 (1954).



J.R.Prescott, Proc. Phys. Soc. 67A, 254 (1954).

Pb^{204} 82 122 68^m

0.374 level
μ +0.14 6 $\gamma\gamma(\theta, H)$
Mass assignment of 68^mPb confirmed
Tl^{203}(d,n)

H.Frauenfelder, J.S.Lawson Jr., W.Jentschke, Phys. Rev. 93, 1126 (1954).

γ (0.905) E4 90% M5 10% $\gamma\gamma(\theta)$
$(0.905\gamma)(0.374\gamma)(\theta)$ I = 6+, 2+, 0+
E4,M5 assignment based on $\alpha_K = 0.06$

H.Frauenfelder, J.S.Lawson, Jr., W.Jentschke, G. DePasquali, Phys. Rev. 92, 1241 (1953).

Pb^{205} 82 123 $\sim 10^{6y}$

τ $> 10^{6y}$
No long-lived Pb activity observed from
Tl(20-Mev d) or decay of 14.5^dBi; chem

P.F.D.Shaw, J.R.Prescott, Proc. Phys. Soc. 67A, 283 (1954).

Pb^{207} 82 125 0.82^s

τ 0.84^s d $\sim 50^y$Bi chem

E.C.Campbell, ORNL-1620 (1953).

$(ce^-_K\ 1.06\gamma)(0.56\gamma)(\theta)$ d $\sim 50^y$Bi
I = 13/2, 5/2, 1/2 scin

F.K.McGowan, Phys. Rev. 92, 524 (1953).

Pb^{210} 82 128 22^y

β^- 0.023 3 pc
F-K plot linear to ~6 kev

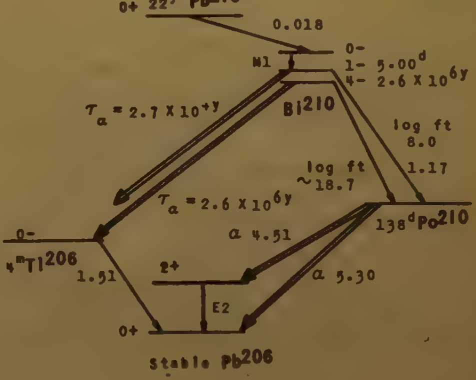
E.Huster, Z. Physik 136, 303 (1953); Naturwiss. 40, 197 (1953); Phys. Rev. 92, 1076 (1953).

γ (0.047) s
$L_1 : L_2 : L_3$: M : NO
39 : 6 : 0.35 : 10 : 3.1* M1
ce^- 0.3* 0.0319 origin unknown
No 0.0075 transition
*ce^- per 100 decays

A.A.Bashilov, B.S.Dzhelepov, L.S.Chervenskaya, Izvest. Akad. Nauk Ser. Fiz. SSSR 17, 428 (1953); Chem. Abstr. 48-2490I (1954).

Not p 2.6×10^{6y} Bi $< 10^{-4}$%
No long-lived α's in Bi extracted from U ore

H.B.Levy, I.Perlman, Phys. Rev. 94, 152 (1954).



Pb^{212} 82 130 10.6^h

γ (0.239)
τ between (20 and 2) x10^{-14}s*

From diffraction of x rays following internal conversion in crystal containing Pb^{212}.

J.W.Knowles, Phys. Rev. 94, 795A(1954); *verbal report.

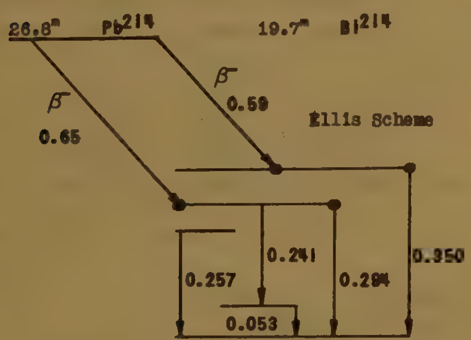
$\Gamma(e^-_K\ 0.239\gamma)$, $\Gamma(e^-_K\ 0.300\gamma) \sim 80$ ev sm
This is expected width of K electron level

H.Slätis, Arkiv Fysik 6, 415 (1953).

Pb^{214} 82 132 26.8^m

β^-	56%	0.59	Rn^{222}	sm
	44%	0.65		

$(0.59\beta)(ce^-0.35\gamma)$ $(0.65\beta)(ce^-0.29\gamma)$
No $(ce^-0.35\gamma)(ce^-0.29\gamma,\ ce^-0.24\gamma)$
Supports decay scheme of Ellis



S.Kageyama, J. Phys. Soc. Japan 8, 689(1953).

Bi^{206} 83 123 6.4^d

		K : L_1L_2 : L_3 : M
γ	0.2025	0.084 : 0.57 : 0.25 : 0.2
	0.516	18 : 10 : 2 : 3

$\tau = 150^{\mu s}$

Both γ's interpreted as E3 from 7– fifth excited state at 2.200 in Pb^{206}

D.E.Alburger, M.H.L.Pryce, Phys. Rev. 92,514, (1953).

Bi^{207} 83 124 $\sim 30^y$

γ	100 %	0.555	$\alpha_K = 0.015$ $\tau < 10^{-9s}$	E2
	81.5%	1.055	$\alpha_K = 0.096$ $\tau = 0.8^s$	M4

$(1.06\gamma)(0.56\gamma)(\theta)$ I = 13/2, 5/2, 1/2 scin
No other γ's

F.K.McGowan, E.C.Campbell, Phys. Rev. 92,523, (1953)

γ 1.0639 *3* sm $\sqrt{2}$
K/L = 3.95
K/LM = 3.00

D.E.Alburger, Phys. Rev. 92, 1257 (1953).

Bi^{209} 83 126 Stable?

Levels $Bi^{209}(n,n')$ $E_n = 2.4$ scin

0.28†	g.s
0.06†	0.9
0.06†	1.3

† $d\sigma/d\omega$ at $\sim 90°$

M.J.Poole, Phil. Mag. 44, 1398 (1953).

Levels $Bi^{209}(n,n'\gamma)$ $E_n = 2.5$
γ 0.85 scin
1.58

E.A.Eliot, D.Hicks, L.E.Beghian, H.Halban, Phys. Rev. 94, 144 (1954).

$Bi^{209}(n,n'\gamma)$ $E_n = 3.9$
γ 0.91 scin
1.63
2.60
3.35

M.A.Rothman, C.E.Mandeville, Phys. Rev. 93, 796 (1954).

$Bi^{209}(p,p'\gamma)$ $E_p = 3$
No γ scin

C.M.Class, C.F.Cook, J.T.Eisinger, Phys. Rev. 94, 809A (1954).

$Bi^{209}(\alpha,\alpha'\gamma)$ $E_\alpha = 3.0$
No γ scin

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93,351 (1954).

Bi^{210} 83 127 5.00^d

I 0?
No hfs in λ 3067 indicating g_I small

M.Fred, F.S.Tomkins, R.F.Barnes, Phys. Rev. 92, 1324 (1953).

β^- 1.170 *10* s

A.A.Bashilov, B.S.Dzhelepov, L.S.Chervinskaya, Izvest. Akad. Nauk Ser. Fiz. SSSR 17,428(1953).

e^-_A	20†	0.075*
	8†	0.080*
	10†	0.086*

*Auger electrons from inner bremsstrahlung
Same lines observed in decay of $60.5^m Bi^{212}$

E.T.Novakow, Bull. Sci. Cons. Acad. Yugoslavie 1, 11(1953); Phys. Abstr. 57-3817 (1954).

Bi^{210} 83 127 2.6×10^{6y}

τ_2 2.6×10^{6y} 8
From difference between σ_t and $\sigma(5.0^d Bi)$

D.J.Hughes, H.Palevsky, Phys. Rev. 92,1206 (1953).

α 4.94 2 Bi^{209}(slow n) ms
No γ, no e^- scin, ppl
D 138.4^dPo 0.37% D 4.19^mTl 99.63%
Not d $22^y Pb^{210}$ $<10^{-4}$%
No long-lived α's in Bi extracted from U ore

H.B.Levy, I.Perlman, Phys. Rev. 94,152(1954).

Bi^{212} 83 129 60.5^m

α 5.481 s
5.603
5.622
5.765
6.047
6.086

A.Rytz, J.recherches centre nat'l. recherche sci. Labs. Bellevue No. 25, 254 (1953).

Bi^{214} 83 131 19.7^m

β^-	20%	1.00?	Rn^{222}	s π
	57%	1.65		
	23%	3.2		

S.Kageyama, J. Phys. Soc. Japan 8, 689 (1953).

$\gamma\gamma$ (θ) found as f(Pb absorber thickness)
Results suggest I = 2, 2, 0 for (1.76 γ) (1.12γ)
I = 2, 2, 0 for (2.09 γ, 1.24 γ) (0.608 γ)

F.Demichelis, R.Malvano, Phys. Rev. 93, 526 (1954); Nuovo Cim. 10,405,1359(1953); Rend. acad. nazl. Lincei 14, 259 (1953).

Po^{210} 84 126 138.4^d

τ 138.37^d 3
0.5 millicurie sample counted 328 days in low geometry α counter

M.L.Curtis, Phys. Rev. 92, 1489 (1953).

Po^{212} 84 128 $0.30^{\mu s}$

α	10^6†*	8.777
	35†*	9.488
	20†*	10.417
	170†*	10.536

No other α with $E_\alpha \leq 11.29$ (< 1.7†)

A.Rytz, J. recherches centre nat'l. recherche sci. Labs. Bellevue No. 25, 254(1953). *Compt. rend. 233, 790 (1951).

Ra^{224} 88 136 3.64^d

α 4.9% 5.445 s
(5.681)

F.Asaro, F.Stephens, Jr., I.Perlman, Phys. Rev. 92, 1495 (1953).

γ 0.2411 α_K = 0.13 Ra^{224} $s\pi$ ce^-
α_{L_3} ~0.08 E2
0.24098 γ reported by Muller et al, Phys. Rev. 88, 775 (1952) in source of Th^{228} + decay products, assigned here

S.Rosenblum, M.Valadares, M.Guillot, J. Phys. radium 15, 129 (1954); Compt. rend. 234,1767 (1952).

Ra^{226} 88 138 1620^y

γ 290† 0.188 K/LM = 0.45 cc
α_K = 0.15* E2
38† 0.66
*Assuming 4.61α in 6.4% of disintegrations

R.R.Roy, M.L.Goes, Compt. rend. 238,469(1954).

γ 0.66 E2 cc
(4.2α) (0.66 ce^-) (θ) I = 0, 2, 0
(4.6α) (0.19 ce^-) (θ) graph*
*Maximum is symmetric about 90°

R.R.Roy, M.L.Goes, Compt. rend. 238, 581(1954).

Ra^{228} 88 140 6.7^y

~4% L x ray crit a
No 0.03γ (< 1%) crit a

M.Riou, Ann. Phys. 8, 535 (1953).

Ac^{228} 89 139 6.13^h

		K	L_1	L_2	L_3	MN*
γ	0.057			24	20	15
	0.078			~0.1		
	0.097		3.3			
	0.127	0.13		3.3	2.3	1.8
	0.184	4.7	1.0			0.3

d Ra^{228} chem sl
ce^-/dis = 0.81 Higher energy γ's not studied
(< 0.060 ce^-)/(> 0.060 ce^-) ~1
e_A/dis = 0.32 x_L/dis = 0.29 (estimated)
*ce^- per 100 disintegrations

W.D.Brodie, Proc. Phys. Soc. 67A, 265 (1954).

Th^{227} 90 137 18.6^d

α	~2%	5.651		Ra(n) chem;	s
	15%	5.704	~2%	5.922	
	~1%	5.728	13%	5.952	
	17%	5.749	21%	5.972	
	2%	5.796	5%	6.001	
	4%	5.860	19%	6.030	

Th^{227} 90 137 18.6^d

γ	0.02997	$L_2/L_3 = 0.33$	E2
	0.03164	$L_2/L_3 = 0.33$	E2
	0.05016		E1
		$L_1 : L_2 : L_3 = 7 : 8 : 10$	
	0.06163	$L_2/L_3 = 0.9$	E2
	0.06867		

Study of higher energy γ's in progress

M.Frilley, S.Rosenblum, M.Valadares, G.Bouissieres, J. Phys. radium 15, 45 (1954).

Th^{228} 90 138 1.90^y

α_2	15%	5.21	DPl
α_1	27%	5.34	
α	58%	(5.42)	

α_1^0[ce$^-$(0.084γ)]
α_2[~0.08 ce$^-$]

C.J.D.Jarvis, Proc. Phys. Soc. 66A, 1074(1953)

α	0.2%	5.173	28 % 5.388		s
	0.4%	5.208	71 % 5.421		
γ	16 †	0.089	$\alpha \sim 16$	E2	scin
	2.6†	0.137	$\alpha \ll 1$	E1	
	0.9†	0.169	$\alpha \sim 1.2$	E2	
	2.7†	0.212	$\alpha \ll 1$	E1	

†Photons per 10^3 α's

F.Asaro, F.Stephens, Jr., I.Perlman, Phys. Rev. 92, 1495 (1953).

γ 0.08447 E2 sπ ce$^-$
$L_2/L_3 = 1.19$
ce$^-$ now attributed to single γ

S.Rosenblum, M.Valadares, M.Guillot, J. Phys. radium 15, 129(1954); Compt. rend. 235, 238 (1952).

γ	100 †	0.0844	Th^{228} source separated from daughters
	10.5†	0.132	
	6 †	0.167	pc
	18 †	0.214	

No Ra K x ray (<0.05†)
γ spectra taken at intervals after separation to identify γ's of daughters

J.O.Newton, B.Rose, Phil. Mag. 45, 58 (1954).

Th^{230} 90 140 8.0x10^{4y}

α	0.06%	4.209	~100% Th^{230} ms
	0.07%	4.293	
	0.08%	4.363	
	0.07%	4.439	
	0.20%	4.474	
	0.07%	4.546	
	23.4%	4.619	
	76.3%	(4.685)	

S.Rosenblum, M.Valadares, J.Blandin-Vial, R.Bernas, Compt. rend. 238, 1496 (1954).

Th^{230} 90 140 8.0x10^{4y}

0.0518 e$^-$(previously unassigned) attributed to L_3 e$^-$ of 0.0678 γ (E2)

M.Riou, Ann. Phys. 8, 535 (1953).

γ (0.068) $\tau < 10^{-8s}$ 90% Th^{230}
(α)(0.068γ)(θ) I = 0, 2, 0 scin

G.M.Temmer, J.M.Wyckoff, Phys. Rev. 92, 913; 849A(1953).

(α)(0.068γ)(θ) I = 0, 2, 0 ic
(α)(0.142γ)(θ) I = 0, 4, 2

P.Falk-Vairant, J.Teillac, G.Valladas, P.Benoist, Compt. rend. 238, 1409 (1954).

Th^{232} 90 142 1.4x10^{10y}

Level $Th^{232}(\alpha,\alpha'\gamma)$ $E_\alpha = 3.0$
γ 0.050 scin

G.M.Temmer, N.P.Heydenburg, Phys. Rev. 93,351 (1954).

$\bar{E}_\alpha$		3.99 2	DPl
α	(25%)	3.95*	
	(75%)	4.00*	

*From analysis of spectrum into two groups differing by 0.055-Mev

G.Philbert, J.Génin, L.Vigneron, J. Phys. radium 15, 16 (1954).

Th^{234} 90 144 24.1^d

β^-	35%	0.100	sπ $\beta\gamma$
	65%	(0.191)	

(0.100β)(0.090γ)

E.F.deHaan, G.J.Sizoo, P.Kramer, Physica 19, 1201 (1953).

Pa^{230} 91 139 17.7^d

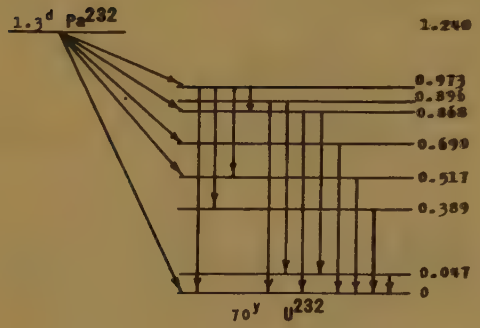
β^-	Th^{232}(26-Mev d)	chem
β^+	0.2	s$\pi\sqrt{2}$
	0.4	
γ	0.0486	s$\pi\sqrt{2}$ ce$^-$
	0.0889	
	0.0995	
	0.462	
ce$^-$	0.417	
	0.424	

Ong Ping Hok, G.J.Sizoo, Physica 20, 77 (1954).

Pa^{232} 91 141 1.3^d

			Th^{232} (20-Mev d)		chem
β^-	74%	0.26	2%	0.715	$s\pi\sqrt{2}$
	13%	0.37	6%	1.24	
	5%	0.54			

				K/L
γ	0.0472	$L_2/L_3 = 1.1$	0.690	
	0.1093	$L_1/L_3 = 2.5$	0.821	4
		K/L	0.844	
	0.389	2	0.868	4
	0.455	4	0.896	>6
	0.517	8.5	0.973	8
	0.584	~1.5	1.085	
	0.662?	<1	1.153	



Ong Ping Hok, G.J.Sizoo, Physica 20, 77 (1954).

Pa^{233} 91 142 27.4^d

			Th^{232} (20-Mev d)		chem
β^-	37%	0.13	8%	0.43	$s\pi\sqrt{2}$
	49%	0.25	6%	0.57	

				$s\pi\sqrt{2}$ ce⁻
γ		0.015	w	0.2726
		0.0286	st	0.3013
		0.0385	vst	0.3126
	w	0.0577	st	0.3401
	st	0.0751	w	0.3763
		0.0866	w	0.3987
		0.1022	w	0.4162

Ong Ping Hok, G.J.Sizoo, Physica 22, 77 (1954).

Pa^{234} 91 143 1.18^m

β^{-*}	0.5%**	0.100	d 24.1^dTh	$s\pi$
	1.4%	0.600		
	2.3%	1.500		
	96.4%	(2.305)		

γ^*	0.230	0.578	$s\pi$ γ(ce⁻)
	0.298	0.728	
	0.356	0.802	
	0.423	0.875	
	0.447	0.926	
	0.500	1.036	

*From spectrum coincident with > 0.09γ's
**Not measured, estimated from decay scheme

E.F.de Haan, G.J.Sizoo, P.Kramer, Physica 19, 1201 (1953).

Pa^{234} 91 143 6.7^h

β^-	33%	0.16	$s\pi\sqrt{2}$
	24%	0.33	U chem
	27%	0.55	
	16%	1.15	

UX contamination 0.5 to 8%

γ		0.064**	vw	0.425*	$s\pi\sqrt{2}$
	st	0.099		0.451	ce⁻
	w	0.127		0.506?	
	st	0.153	st	0.567	
		0.200		K/L = 6	
	st	0.225	vw	0.690	
		K/L = 4.5		0.731*	
	w	0.280		0.800	
		0.293		0.877	
	st	0.369		0.924*	

*e_K^- only seen
**From 0.042 e⁻ (assumed e_L^-) and doubtful 0.059 e⁻ (assumed e_M^-). Note 0.044γ in Pu^{238} decay.

Ong Ping Hok, G.J.Sizoo, Physica 19,1205(1953).

U^{232} 92 140 74^y

τ 74^y

From specific α activity; ms analysis

P.A.Sellers, C.M.Stevens, M.H.Studier, Phys. Rev. 94, 952 (1954).

U^{233} 92 141 1.62×10^{5y}

I	5/2	S
μ	positive	
q	large	

K.L.Vander Sluis, J.R.McNally, Jr., J. Opt. Soc. Amer. 44, 87 (1954).

U^{234} 92 142 2.5×10^{5y}

α	~3%	4.593	enriched U^{234}
	23%	4.707	αe^- ic
	74%	(4.763)	

G.Valladas, Compt. rend. 237,1673 (1953).

U^{235} 92 143 7.1×10^{5y}

I	5/2	S
μ	-0.8	
Q	~8	

K.L.Vander Sluis, J.R.McNally, Jr., J. Opt. Soc. Amer., 44, 87 (1954).

U^{238} 92 146 4.49×10^{9y}

Level	U($\alpha,\alpha'\gamma$)	E_α = 3.0	
γ	0.044		scin
No 0.424γ*			

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 93,906 (1954); * priv. comm.

Np^{238} 93 145 2.1^d

β^-	45%	~0.27		U(12-Mev p)chem; sl
	55%	1.26*		
γ	649†	0.0441	$L_2 : L_3 : M = 29 : 21 : 15$	
	30†	0.1020	$L_2 : L_3 : M = 14 : 9 : 7$	
	0.5†	0.925?		
	1.6†	0.939	$K/L_2 = 1.7$	
	3.9†	0.986	$K/L_2 = 2$	
	3.6†	1.030	$K : L_2 : M_2 = 22 : 8 : 6$	

*Combination of 1.246 and 1.290?
†ce^- per 1000 disintegrations

H.Slätis, J.O.Rasmussen, Jr., H.Atterling, Phys. Rev. 93, 646 (1954).

Pu^{238} 94 144 90^y

α	0.09%	5.352	2 sources with known amounts Pu^{238}	
	28%	5.452		
	72%	5.495		s
γ	0.038†	0.0438		pc
	0.008†	0.099		
	0.001†	0.150		
x	13†	L x ray		

†Photons per 100 α's Cf. $6.7^h Pa^{234}$

F.Asaro, I.Perlman, Phys. Rev. 94, 381 (1954).

Pu^{239} 94 145 2.4×10^{4y}

I	1/2	S

H.Van den Berg, P.F.A.Klinkenberg, Physica 20, 37 (1954).

τ	2.44×10^{4y} 5	U(n)	chem

From specific α activity of four Pu samples corrected to zero content of Pu^{238} and Pu^{240}

G.W.Farwell, J.E.Roberts, A.C.Wahl, Phys. Rev. 94, 363 (1954).

Pu^{240} 94 146 6580^y

τ	6.3×10^{3y} 6	U(n)	chem

From specific α activity of four Pu samples with known Pu^{238}, Pu^{239}, and Pu^{240} content

G.W.Farwell, J.E.Roberts, A.C.Wahl, Phys. Rev. 94, 363 (1954).

Am^{242} 95 147 16.0^h

τ	16.01^h 2	Am^{241}(pile n)

Counted 10 samples each for 7 half lives

T.K.Keenan, R.A.Penneman, B.B.McInteer, J. Chem. Phys. 21, 1802 (1953); Phys. Rev. 87, 204A (1952).

Am^{243} 95 148 8800^y

I	5/2	S

$\mu(Am^{241})/\mu(Am^{243}) \sim 1$

J.G.Conway, R.D.McLaughlin, Phys. Rev. 94, 498 (1954).

Am^{243} 95 148 8800^y

τ	8.8×10^{3y} 6	ms

From Am^{243} to Am^{241} α activity ratio in sample with known mass ratio

H.Diamond, P.R.Fields, J.Mech, M.G.Inghram, D.C.Hess, Phys. Rev. 92, 1490 (1953).

α	~3%	5.171			Pu^{239}(pile n) s
	13%	5.225			
	84%	5.267			
γ		0.075	$\alpha \leq 0.25$	E1	scin

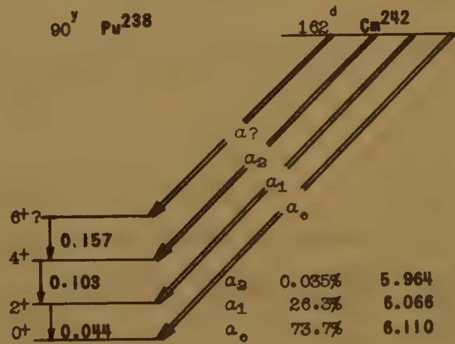
No 5.342 α (<2%)

F.Asaro, I.Perlman, Phys. Rev. 93, 1423 (1954).

Cm^{242} 96 146 162^d

α	0.035%	5.964		$Am^{241}(n,\gamma\beta)$ chem
	26.3%	6.066		s
	73.7%	6.110		
γ	410†	0.044	$\alpha = 620$	scin
	60†	0.100	$\alpha = 5$	
	27†	0.157		

†Photons per 10^6 α's



F.Asaro, S.G.Thompson, I.Perlman, Phys. Rev. 92, 694 (1953).

Cm^{243} 96 147 $\sim 100^y$

α	13%	5.732	$Cm^{242}(n,\gamma)$ chem
	81%	5.777	s
	6%	5.985	
γ		0.226	scin
		0.278	

$(5.777\alpha)(0.226\gamma, 0.278\gamma)$

F.Asaro, S.G.Thompson, I.Perlman, Phys. Rev. 92, 694 (1953).

Cm^{244} 96 148 19^y

α	5.755	$Pu^{242}(n,\gamma\beta)(n,\gamma\beta)$ chem
	5.798	s

F.Asaro, S.G.Thompson, I.Perlman, Phys. Rev. 92, 694 (1953).

Bk^{249}? 97 152 $>7^d$ | τ $>7^d$ | Pu^{239}(pile n) chem
β^-

S.G.Thompson, A.Ghiorso, B.G.Harvey, C.R.Choppin, Phys. Rev. 93, 908 (1954).

Cf^{247}? 98 149 $\sim 2.7^h$ | τ $\sim 2.7^h$ | U^{238}($\sim$100-Mev N) chem
ϵ

A.Ghiorso, G.B.Rossi, B.G.Harvey, S.G.Thompson Phys. Rev. 93, 257 (1954).

Cf^{248} 98 150 225^d | τ 225^d | U^{238}($\sim$100-Mev N) chem
α 6.26

A.Ghiorso, G.B.Rossi, B.G.Harvey, S.G.Thompson Phys. Rev. 93, 257 (1954).

$Cf^{>248}$ 98 >150 $>7^d$ | τ $>7^d$ | Pu^{239}(pile n) chem
α 5.8, 6.05, 6.15

S.G.Thompson, A.Ghiorso, B.G.Harvey, C.R.Choppin, Phys. Rev. 93, 908 (1954).

99^{246} 147 | τ minutes | U^{238}($\sim$100-Mev N) chem
ϵ
Observed only through growth of 1.5^dCf

A.Ghiorso, G.B.Rossi, B.G.Harvey, S.G.Thompson Phys. Rev. 93, 257 (1954).

99^{247}? 148 7.3^m | τ 7.3^m | U^{238}($\sim$100 Mev-N) chem
ϵ?
α 7.35

A.Ghiorso, G.B.Rossi, B.G.Harvey, S.G.Thompson Phys. Rev. 93, 257 (1954).

99^{253}? 154 19^d | τ 19.3^d | Pu(pile n) chem
α 6.61 | lc

M.H.Studier, P.R.Fields, H.Diamond, J.F.Mech, A.M.Friedman, P.Sellers, G.Pyle, C.M.Stevens, L.B.Magnusson, J.R.Huizenga, Phys. Rev. 93, 1428; 94, 209 (1954).

τ 20^d | d$\sim 20^d$ Cf chem
α 6.63 | lc

G.R.Choppin, S.G.Thompson, A.Ghiorso, B.G.Harvey, Phys. Rev. 94, 1080 (1954).

99^{254}? 37^h | τ 37^h | 99(pile n) chem

P.R.Fields, M.H.Studier, J.F.Mech, H.Diamond, A.M.Friedman, L.B.Magnusson, J.R.Huizenga, Phys. Rev. 94, 209 (1954).

100^{254}? 3.2^h | τ 3.3^h | 99(pile n) chem
α 7.17 | d 37^h99 lc

P.R.Fields, M.H.Studier, J.F.Mech, H.Diamond, A.M.Friedman, L.B.Magnusson, J.R.Huizenga, Phys. Rev. 93, 1428; 94, 209 (1954).

τ 3.2^h | d 37^h99 chem
α 7.22 | lc

G.R.Choppin, S.G.Thompson, A.Ghiorso, B.G.Harvey, Phys. Rev. 94, 1080 (1954).

2. NEUTRON CROSS SECTIONS

Absorption cross sections for neutron energies marked "th" (thermal) have been determined, from measurements in a thermal neutron flux, in terms of the cross section value of a "standard" for neutrons of velocity 2200 m/sec. or energy ~0.025 ev. The standard used is stated just after the reference and is generally one known to have a thermal absorption cross section with a 1/v energy dependence. If the nucleus whose cross section is being measured also has a cross section with 1/v dependence, the cross section found for it by comparison with the standard will, of course, be a cross section for 2200 m/sec. If not, and the dependence often is not known, the value found by the comparison is $\overline{\sigma v}/2200$.

Target	Energy	σ	Value	Method	Ref.
H	1.005	t	4.23		54F9
	2.540	t	2.525		54F9
	14.1-18.0	t	table		54C16
	19.93	t	0.50	1	53D28
	169	t	0.049		53T20
	410	t	0.034		54N8
H^2	14.1-18.0	t	table		54C16
	169	t	0.023		53T20
	410	t	0.062		54N8
He	2.61-14.3	el(θ)	graphs	ic	53S69
	2.49	t	3.16		53C49
	2.99	t	2.79		53C49
	18.0	t	0.85		53D28
	19.0	t	0.82		53D28
	20.1	t	0.77		53D28
Li	14.1-18.0	t	table		54C16
Li^6	1.5	n, H^3	0.32	ppl	54W6
	2.0	n, H^3	0.27	ppl	54W6
	14	n,p	0.006	ppl	54F3
	14	n, 10.4-Mev d	0.077	ppl	54F3
	14	n, 13.1-Mev d	0.089	ppl	54F3
	14	n, H^3	0.026	ppl	54F3
Li^7	~3	n, H^3	0.070	$12.4^{y}H^3$	54B22
	~4.5	n, H^3	0.030	$12.4^{y}H^3$	54B22
	14	n,p	< 0.005	ppl	54F3
	14	n, H^3	0.055	ppl	54F3
Be	14.1-18.0	t	table		54C16
	410	t	0.231		54N8
B	0.001-0.036ev	t	graph	chopper	53C35
	0.0253ev	a	749*	4	53C35
	Value from 1/v line				
	<0.2% H_2O by weight in B_2O_3 sample				
	0.025 ev	a	755	3	53K54
B^{10}	14.1-18.0	t	table		54C16
B^{11}	14.1-18.0	t	table		54C16
C	2.20	el	1.65		53R25
	14.1-18.0	t	table		54C16
	17.2-20.1	t	table		53D28
	169	t	0.323		53T20
	410	t	0.297		54N8
N^{14}	14	n,2n	~0.0034	$10.1^{m}N$	54D9
O	12-18	n,p	graph	$7.4^{s}N$	54M2
	14.1-18.0	t	table		54C16
	169	t	0.430		53T20
	410	t	0.378		54N8
F^{19}	19.0	t	1.84		53D28
Mg	14.1-18.0	t	table		54C16
Al^{27}	2.5	el	1.0	scin	53P17
	2.5	n, 1.4n'	0.5	scin	53P17
	14.1-18.0	t	table		54C16
	19.0	t	1.84		53D28
	410	t	0.587		54N8
Si	19.0	t	1.94		53D28
Si^{30}	pile	n,γ	0.094	$2.65^{h}Si$	54L3
P^{31}		s coh	3.7		53P21
	0.13-0.85	t	graph		53H35
S	14.1-18.0	t	table		54C16
	410	t	0.672		54N8
S^{32}	pile	n,p	0.15	$14.3^{d}P$	53S66
Cl	410	t	0.74		54N8
A	0.45-1.10	t	graph		53G33
Ti	1.0	el(θ)	graph	pc	54W13
Cr	2.5	n, 1.1n'	1.0	scin	54E8
	0.015-10^4 ev	t	graphs		54M51

Neutron Cross Sections continued

Target	Energy	σ	Value	Method	Ref.
Fe	1.0	el(θ)	graph	pc	54W13
	2.5	n, 1.6n'	1.0	scin	54E8
	19.0	t	2.23		53D28
	410	t	1.07		54N8
Fe^{54}	pile	n,γ	2.2	2.9^{y}Fe	54R13
	pile	n,p	0.011	320^{d}Mn	53S66
Fe^{58}	pile	n,γ	0.98	45^{d}Fe	54R13
Co^{59}	1.0	el(θ)	graph	pc	54W13
Ni	1.0	el(θ)	graph	pc	54W13
	2.8	el	0.9	scin	53P17
	2.8	n, 1.4n'	0.6	scin	53P17
	0.002–0.8 ev	t	graph		54G21
Cu	1.0	el(θ)	graph	pc	54W13
	19.0	t	2.56		53D28
	410	t	1.19		54N8
Zn	1.0	el(θ)	graph	pc	54W13
Ga	0.05–10^{4} ev	t	graph		53M51
Se	1.0	el(θ)	graph	pc	54W13
Br	17.2–20.1	t	table		53D28
Sr	1.0	el(θ)	graph	pc	54W13
Zr	1.0	el(θ)	graph	pc	54W13
	19.0	t	3.60		53D28
Nb^{93}	1.0	el(θ)	graph	pc	54W13
Nb^{94}	pile	n,γ	graph	35^{d}Nb	53D18
Mo	1.0	el(θ)	graph	pc	54W13
Ru	0.01–10^{3} ev	t	graph		53M51
Pd	10–50 ev	t	graph		54L12
Ag	1.0	el(θ)	graph	pc	54W13
Cd	1.0	el(θ)	graph	pc	54W13
	0.002–0.6 ev	t	graph		54G21
	410	t	1.85		54N8
In	1.0	el(θ)	graph	pc	54W13
	2.5	n, 1.6n'	0.4	scin	54E8
	2.5	n, 1.9n'	0.2	scin	54E8
In^{115}	0.4–1.8	n,n'	graph	4.5^{h}In	54E1
	0.4–5.5	n,n'	graph	4.5^{h}In	54M8

Neutron Cross Sections continued

Target	Energy	σ	Value	Method	Ref.
Sn	1.0	el(θ)	graph	pc	54W13
Sn^{116}	~14	n,p	0.9 mb	13^{s}In	53W48
Sn^{118}	~14	n,p	0.8 mb	4.5^{m}In	53W48
Sb	1.0	el(θ)	graph	pc	54W13
Te	1.0	el(θ)	graph	pc	54W13
Cs^{133}	1–9 ev	t	graph		54L12
Ba	1.0	el(θ)	graph	pc	54W13
Ce	1.0	el(θ)	graph	pc	54W13
Nd	0.06–3	t	graph		54O2
Sm	0.005–0.18 ev	t	graph		54M6
	0.06–3	t	graph		54O2
Ho^{165}	0.3–50 ev	t	graph		54F19
Er		s coh	7.8		53K53
	0.06–3	t	graph		54O2
Tm^{169}	0.1–50 ev	t	graph		53F19
Yb	0.06–3	t	graph		54O2
Lu	0.03–35 ev	t	graph		53F19
Hf	1.0	el(θ)	graph	pc	54W13
	1–10^{3} ev	t	graph		53B78
	0.06–3	t	graph		54O2
Hf^{176}	0.8–16 ev	t	graph		53B78
Hf^{177}	th	a	~350	osc	53B78
	0.8–16 ev	t	graph		53B78
Hf^{178}	th	a	~90	osc	53B78
	0.8–16 ev	t	graph		53B78
Hf^{179}	th	a	~75	osc	53B78
	0.8–16 ev	t	graph		53B78
Hf^{180}	0.8–16 ev	t	graph		53B78
Ta^{181}	1.0	el(θ)	graph	pc	54W13
	0.3–50 ev	t	graph		53C45
	5–5000 ev	t	graph		53M51
Ta^{182}	th	n,γ	$\geq 10^{4}$	5.2^{d}Ta	53D20
W	1.0	el(θ)	graph	pc	54W13
	2.5	n, ~1.5n'	1.3	scin	53P17
	2.5	n, >2n'	1.6	scin	53P17
Re	0.003–10^{4} ev	t	graph		53M51

Neutron Cross Sections continued

Target	Energy	σ	Value	Method	Ref.
Au^{197}	1.0	el(θ)	graph	pc	54W13
	0.4-5.0	n,n'	graph	7.4^sAu	54M8
	0.53-2.0	n,n'	graph	7.4^sAu	54E1
	2.5	n, ~1.5n'	0.9	scin	53P17
	2.5	n, >2n'	2.5	scin	53P17
	0.0253 ev	a	98.7* σ		53C35
*Value from 1/v line plus 1% for 4.9 ev res.					
	0.0013-0.036 ev	t	graph		53C35
	0.3-100 ev	t	graph		54L12
Hg	1.0	el(θ)	graph	pc	54W13
Pb	1.0	el(θ)	graph	pc	54W13
	19.0	t	5.96		53D28
	410	t	2.89		54N8
Pb^{206}	1.0	el(θ)	graph	pc	54W13
Bi^{209}	1.0	el(θ)	graph	pc	54W13
	2.4	el	2.9	scin	53P17
	2.4	n, 1.1n'	0.3	scin	53P17
	2.5	n, 0.9n'	0.6	scin	54E8
	2.4	n, 1.5n'	0.8	scin	53P17
	2.5	n, 1.6n'	1.2	scin	54E8
	19.0	t	5.69		53D28
	45-131	t	table		54L4
Th	1.0	el(θ)	graph	pc	54W13
	410	t	3.21		54N8
Th^{230}	th	a	26		53P23
U	0.002-0.8 ev	t	graph		54G21
	0.02-7.6	t	graph		54H17
	17-20	t	6		54H17
	18-20.1	t	table		53D28
	45-131	t	table		54L4
	410	t	3.23		54N8
Pu^{242}	pile	n,γ	~30		54S5
Pu^{243}	pile	n,γ	~100		54S5
$16^h Am^{242}$	pile	n,f	2950		54H13
99^{253}	pile	n,γ	~240	$37^h 99^{254}$	54F14

53B78 L.M.Bollinger, S.P.Harris, C.T.Hibdon, C.O. Muehlhause, Phys. Rev. 92, 1527(1953); 87,222A (1952); Based on σ_a(B) = 755.

53C35 R.S.Carter, H.Palevsky, V.W.Myers, D.J.Hughes, Phys. Rev. 92,716(1953); 91, 450A(1953).

53C45 R.L.Christensen, Phys. Rev. 92, 1509(1953).

53C49 J.H.Coon, quoted by J.D.Seagrave, Phys. Rev. 92, 122 (1953).

53D18 D.L.Douglas, A.C.Mewherter, R.P.Schuman, Phys. Rev. 92, 369, 1095A (1953).

53D20 J.W.M.DuMond, H.C.Hoyt, P.E.Marmier, J.J.Murray, Phys. Rev. 92, 202 (1953).

53D28 R.B.Day. R.L.Henkel, Phys. Rev. 92,358(1953).

53F19 H.L.Foote, Jr., H.H.Landon, V.L.Sailor, Phys. Rev. 92, 656(1953).

53G33 J.B.Guernsey, C.Goodman, Phys. Rev. 92,323(1953); 91, 404A(1953).

53H35 K.F.Hansen, R.M.Kiehn, C.Goodman, Phys. Rev. 92, 652(1953).

53K53 W.C.Koehler, E.O.Wollan, Phys. Rev. 92,1380 (1953).

53K54 C.W.Kimball, G.R.Ringo, T.R.Robillard, S.Wexler, quoted by B.Hamermesh, G.R.Ringo, S.Wexler, Phys. Rev. 90, 603 (1953).

53M52 E.Melkonian, W.W.Havens, Jr., L.J.Rainwater, Phys. Rev. 92, 702 (1953).

53P17 M.J.Poole, Phil. Mag. 44, 1398 (1953); Isotropy assumed.

53P21 S.W.Peterson, H.A.Levy, S.H.Simonsen, J. Chem. Phys. 21, 2084 (1953).

53P23 H.Pomerance, ORNL-1620 (1953); Based on σ_a(Au) = 95.

53R25 R.Ricamo, Nuovo Cim. 10, 1607 (1953).

53S66 G.H.Stafford, L.H.Stein, Nature 172,1103 (1953).

53S69 J.D.Seagrave, Phys. Rev. 92, 122 (1953).

53T20 A.E.Taylor, Phys. Rev. 92, 1071 (1953).

53W48 Z.Wilhelmi, R.Brunsz, C.Dabrowski, Bull. Akad. Polon, Sci. I, 105 (1953).

54B22 H.E.Banta, R.L.Macklin, Phys. Rev. 94, 807A (1954); Science 119, 350.

54C16 C.F.Cook, T.W.Bonner, Phys. Rev. 94, 651(1954).

54D9 J.D.Dudley, C.M.Class, Phys. Rev. 94, 807A(1954).

54E1 A.A.Ebel, C.Goodman, Phys. Rev. 93,197(1954).

54E8 E.A.Eliot, D.Hicks, L.E.Beghian, H.Halban, Phys. Rev. 94, 144 (1954).

54F3 G.M.Frye, Jr., Phys. Rev. 93, 1086 (1954).

54F9 R.E.Fields, R.L.Becker, R.K.Adair, Phys. Rev. 94, 389 (1954).

54F14 M.H.Studier, P.R.Fields, H.Diamond, J.F.Mech, A.M.Friedman, P.Sellers, G.Pyle, C.M.Stevens, L.B.Magnusson, J.R.Huizenga, Phys. Rev. 93, 1428 (1954).

54G21 E.Gatti, E.Germagnoli, G.Perona, Nuovo Cim. 11, 262 (1954).

54H13 G.H.Higgins, W.W.T.Crane, Phys. Rev. 94, 735 (1954).

54H17 R.L.Henkel, L.Cranberg, G.A.Jarvis, R.Nobles, J.E.Perry, Jr., Phys. Rev. 94, 141 (1954).

54L3 W.S.Lyon, J.J.Manning, Phys. Rev. 93,501(1954).

54L4 W.I.Linlor, B.Ragent, Phys. Rev. 92, 835(1953); 93, 951A (1954).

54L12 H.H.Landon, V.L.Sailor, Phys. Rev. 93, 1030 (1954).

54M2 H.C.Martin, Phys. Rev. 93, 498 (1954).

54M6 A.W.McReynolds, E.Andersen, Phys. Rev. 93, 195, (1954).

54M8 H.C.Martin, B.C.Diven, R.F.Taschek, Phys. Rev. 93, 199 (1954); 92, 1096A (1953).

54N8 V.A.Nedzel, Phys. Rev. 94, 174 (1954).

54O2 A.Okazaki, S.E.Darden, R.B.Walton, Phys. Rev. 93, 461 (1954).

54R13 S.A.Reynolds, G.W.Leddicotte, W.S.Lyon, ORNL 54-1-29(1954); Based on σ_a(Co) = 34.

54S5 M.H.Studier, P.R.Fields, P.Sellers, A.M.Friedman, C.M.Stevens, J.F.Mech, H.Diamond, J.Sedlet, J.R.Huizenga, Phys. Rev. 93, 1433 (1954).

54W6 J.B.Weddell, J.H.Roberts, Phys. Rev. 93, 924A (1954).

54W13 M.Walt, H.H.Barschall, Phys. Rev. 93, 1062(1954).

3. GROUND STATE Q'S

For these data it seemed impractical to follow the policy adhered to in the main list of giving the A value of a target nucleus only when enriched material was used or when the target element is known to be monoisotopic. In the following reactions, the A values assigned by the experimenters to target and product nuclei are given as superscripts. In cases where enriched material was used, the superscript is underlined.

The standard given is that used for the measurement of the energy of either the incident or the emitted light particle whichever presented the greatest difficulty. In cases where the same standard was used for both measurements, special mention of this fact is made in the footnote giving the value assigned to the standard.

Reaction	Value		Source	Detector	Standard	Ref.
$H^{\underline{3}}(He^3,p)He^5$	+11.08		Ccw	scin	range energy[a]	53M61
$He^{\underline{3}}(d,\gamma)Li^5$	+16.6	2	VdG	scin	$Li^7(p,\gamma)$	54H3
$He^5 \longrightarrow He^4+n$	+1.00	8	From $H^3(He^3,p)He^5$Q			53M61
$He^5 \longrightarrow He^4+n$	+1.09	10	From $Li^6(n,d)He^5$Q			54F3
$Li^{\underline{6}}(n,d)He^5$	-2.57	10	Ccw	ppl	$Li^6(n,t)$	54F3
$Be^8 \longrightarrow 2He^4$	+0.0775 value retracted					53A34
$B^{\underline{10}}(d,\alpha)Be^8$	+17.829	10	Ccw	s	p res	54E10
$B^{10}(d,p)B^{11}$	+9.227	5	Ccw	s	p res	54E10
$B^{10}(\alpha,d)C^{12}$	+1.39	1		s		53S64
$B^{10}(\alpha,p)C^{13}$	+4.13	2		s		53S64
$B^{\underline{11}}(d,\alpha)Be^9$	+8.029	5	Ccw	s	p res	54E10
$B^{11}(d,p)B^{12}$	+1.140	8	VdG	s	Po α^b	53E12
$B^{11}(\alpha,p)C^{14}$	+0.85	2		s		53S64
$C^{12}(d,p)C^{13}$	+2.720	2	Ccw	s	p res	54E10
$N^{14}(p,n)O^{14}$	-6.0	2	Cyc	ppl		54A11
$N^{14}(\alpha,p)O^{17}$	-1.16		Po α	ppl		53H33
$Mg^{26}(p,\gamma)Al^{27}$	+8.23	9	Ccw	scin	$F^{19}(p,\alpha\gamma)$	54K9
$Ne^{20}(n,\alpha)O^{17}$	-0.70	2		ic		53F30
$Cl^{35}(\alpha,p)A^{38}$	+0.81	8	Cyc	a		53K31
$Ca^{40}(d,p)Ca^{41}$	+6.14	1	VdG	s		54B31
$Ca^{40}(p,n)Sc^{40}$	-15.5	1.0	Cyc	0.22^sSc		54G9
$V^{\underline{51}}(d,p)V^{52}$	+5.072	8	VdG	s	Po α^b	53S56
$Ni^{60}(p,n)Cu^{60}$	-6.6	4	Cyc	23^mCu		54C15
$Cu^{63}(\gamma,n)Cu^{62}$	-10.61	5	βtron	9.8^mCu	Q value masses	54B4
$Cu^{63}(p,n)Zn^{63}$	-4.21					54C12
$Cu^{65}(p,n)Zn^{65}$	-2.12					54C12
$Zn^{\underline{68}}(d,p)Zn^{69}$	+4.16	15		scin		54E2
$As^{\underline{75}}(n,\gamma)As^{76}$	+7.30	4	Pile	s pr	p res	53B76
$Se^{76}(n,\gamma)Se^{77*}$	+7.416	9	Pile	s pr	p res	53K45
$Se^{77}(n,\gamma)Se^{78*}$	+10.483	14	Pile	s pr	p res	53K45
$Kr^{\underline{84}}(d,p)Kr^{85}$	+3.72	5	Cyc	a		53W34
$Kr^{\underline{86}}(d,p)Kr^{87}$	+3.30	5	Cyc	a		53W34
$Sr^{86}(n,\gamma)Sr^{87*}$	+8.433	14	Pile	s pr	p res	53K45
$Sr^{87}(n,\gamma)Sr^{88*}$	+11.07	6	Pile	s pr	p res	53K45
$Zr^{91}(n,\gamma)Zr^{92*}$	+8.66	4	Pile	s pr	p res	53K45
$Nb^{\underline{93}}(n,\gamma)Nb^{94}$	+7.19	3	Pile	s pr	p res	53B76
$Mo^{95}(n,\gamma)Mo^{96*}$	+9.15	5	Pile	s pr	p res	53K45
$Rh^{\underline{103}}(n,\gamma)Rh^{104}$	+6.792	14	Pile	s pr	p res	53B76
$Ag^{107}(n,\gamma)Ag^{108*}$	+7.27	2	Pile	s pr	p res	53B76
$Ag^{109}(\gamma,n)Ag^{108}$	-9.07	7	βtron	2.3^mAg	Q value masses	54B4
$Cd^{113}(n,\gamma)Cd^{114}$	+9.046	8	Pile	s pr	p res	53K45
Mass assignment because of large σ_a (Cd^{113})						
$Sn^{\underline{124}}(d,p)Sn^{125}$	+3.52	7	Cyc			53W49
$Sb^{121}(n,\gamma)Sb^{122*}$	+6.80	4	Pile	s pr	p res	53B76
$Te^{\underline{124}}(d,p)Te^{125}$	+4.25	7	Cyc			53W49
$Pr^{\underline{141}}(n,\gamma)Pr^{142}$	+5.83	3	Pile	s pr	p res	53B76
$Sm^{149}(n,\gamma)Sm^{150}$	≥7.89	6	Pile	s pr	p res	53K45
Mass assignment because of large σ_a (Sm^{149}). See Sm^{150}.						
$Ta^{\underline{181}}(n,\gamma)Ta^{182}$	+6.07	7	Pile	s pr	p res	53B76
$W^{182}(n,\gamma)W^{183*}$	+6.182	8	Pile	s pr	p res	53K45
$W^{183}(n,\gamma)W^{184*}$	+7.42	2	Pile	s pr	p res	53K45
$Pt^{194}(n,\gamma)Pt^{195*}$	+6.07	4	Pile	s pr	p res	53K45
$Pt^{195}(n,\gamma)Pt^{196*}$	+7.920	12	Pile	s pr	p res	53K45
$Au^{\underline{197}}(n,\gamma)Au^{198}$	≥6.494	8	Pile	s pr	p res	53B76
See Au^{198} in main list.						
$Tl^{203}(n,\gamma)Tl^{204*}$	+6.54	3	Pile	s pr	p res	53B76
$Tl^{205}(n,\gamma)Tl^{206*}$	+6.20	3	Pile	s pr	p res	53B76

Ground State Q's continued

a Range energy data of Smith, Phys. Rev. 71,32(1947).

b $H_\rho(\text{Po }\alpha) = 331{,}590$. This standard was used for both incident and emitted particles.

* For evidence for mass assignment see item (by same authors) in main list under this nucleus or appropriate element.

53A34 S.K.Allison, Phys. Rev. 91, 882 (1953).

53B76 G.A.Bartholomew, B.B.Kinsey, Can. J. Phys. 31, 1025 (1953).

53E12 M.M.Elkind, Phys. Rev. 92, 127 (1953).

53H33 E.Hjalmar, H.Slätis, Arkiv. Fysik 6, 451; Phys. Rev. 89, 1151 (1953).

53K31 A.Z.Kranz, W.W.Watson, Phys. Rev. 91, 1472(1953).

53K45 B.B.Kinsey, G.A.Bartholomew, Can. J. Phys. 31, 1051 (1953).

53M61 C.D.Moak, Phys. Rev. 92, 383; 91, 462A (1953).

53S56 J.E.Schwager, L.A.Cox, Phys. Rev. 92, 102 (1953).

53S64 E.S.Shire, J.R.Wormald, G.Lindsay-Jones, A.Lundén, A.G.Stanley, Phil. Mag. 44, 1197 (1953).

53W34 G.W.Wheeler, R.B.Schwartz, W.W.Watson, Phys. Rev. 92, 121 (1953).

Ground State Q's continued

53W49 N.S.Wall, Phys. Rev. 92, 1526 (1953).

54A11 F.Ajzenberg, W.Franzen, Phys. Rev. 94, 409 (1954); 93, 925A(1954).

54B4 M.Birnbaum, Phys. Rev. 93, 146(1954); 91, 474A(1953).

54B31 C.M.Braams, Phys. Rev. 94, 763A(1954).

54C12 C.F.Cook, T.W.Bonner, Phys. Rev. 94, 807A(1954).

54C15 B.L.Cohen, E.Newman, R.A.Charpie, T.H.Handley, Phys. Rev. 94, 620 (1954).

54E2 F.S.Eby, R.D.Hill, W.K.Jentschke, Phys. Rev. 93, 925A (1954).

54E10 R.B.Elliott, D.J.Livesey, Proc. Roy. Soc. 224A, 129 (1954).

54F3 G.M.Frye, Jr., Phys. Rev. 93, 1086 (1954).

54G9 N.W.Glass, J.R.Richardson, Phys. Rev. 93, 942A(1954).

54H3 N.M.Hintz, J.M.Blair, D.M.VanPatter, Phys. Rev. 93, 910, 924A (1954).

54K9 J.C.Kluyver, G.Verploegh, Physica 20, 178 (1954).

4. MASS DIFFERENCES AND RATIOS

Where no superscripts have been used with H, C, and O, the weights of the most abundant isotopes, namely 1, 12, and 16 respectively, are to be understood.

Differences are given in millimass units

	Value		Ref.
$H_2 - H^2$	+1.5473	7	54M37
$H^2_2 - He$	+25.6060	47	54M37
$H^2_2 - HeH$	+25.6074	26	54M37
$2H^2_3 - C$	+84.6508	102	54M37
$2He_2 - O$	+15.5086	88	54M37
$2HeH^2 - C$	+33.4282	68	54M37
$CH_4 - O$	+36.4086	38	54M37
	+36.399	28	53E15
$N^{14} - CH_2$	-12.5999	36	54M37
	-12.591	13	53E15
$1/2(2N^{14} - C_2H_4)$	-12.589	21	53E15
$NH_3 - OH$	+23.750	8	54M37
$\frac{Si^{30} - Si^{29}}{Si^{30} - Si^{28}}$	0.49934	3	53W39
Cl^{35}/Cl^{37}	0.945978	3	53H51
$A^{40} - C_3H_4$	-69.052	44	53E15
$3Ti^{47} - Pr^{141}$	-50.9	3	53H58
$3Ti^{48} - Nd^{144}$	-66.7	3	53H58
$3Ti^{50} - Nd^{150}$	-85.2	5	53H58
$3Cr^{52} - Gd^{156}$	-100.4	4	53H58
$3Mn^{55} - Ho^{165}$	-84.8	8	54H4
$3Fe^{56} - Er^{168}$	-126.0	3	54H4
$Ga^{69} - C_5H_9$	-144.75	4	53C20
$3Ga^{69} - Pb^{207}$	-196.6	6	53H58
$Ga^{71} - C_5H_{11}$	-161.30	8	54C20
$Ge^{70} - C_5H_{10}$	-154.30	6	54C20
$2Ge^{70} - Ce^{140}$	-56.8	6	53H58
$Ge^{72} - C_5H_{12}$	-172.35	5	54C20
$2Ge^{72} - Nd^{144}$	-66.3	2	53H58
$2Ge^{72} - Sm^{144}$	-66.9	8	54H4
$Ge^{73} - C_6H$	-84.51	3	54C20
$2Ge^{73} - Nd^{146}$	-65.8	4	54H4
$Ge^{74} - C_6H_2$	-94.68	6	54C20
$2Ge^{74} - Nd^{148}$	-74.8	2	54H4
$2Ge^{74} - Sm^{148}$	-71.9	4	54H4
$Ge^{76} - C_6H_4$	-110.05	4	54C20
$2Ge^{76} - Sm^{152}$	-76.2	2	53H58
$As^{75} - C_6H_3$	-101.79	4	54C20
$2As^{75} - Nd^{150}$	-77.4	4	54H4
$2As^{75} - Sm^{150}$	-72.5	8	54H4

MASS DIFFERENCES AND RATIOS continued

	Value		Ref.
$Se^{74} - C_6H_2$	−93.14	7	54C20
$2Se^{74} - Nd^{148}$	−72.3	4	54H4
$2Se^{74} - Sm^{148}$	−70.0	5	54H4
$Se^{76} - C_6H_4$	−112.06	4	54C20
$2Se^{76} - Sm^{152}$	−81.4	6	53H58
$2Se^{77} - Sm^{154}$	−81.8	3	54H4
$2Se^{77} - Gd^{154}$	−81.0	2	54H4
$2Se^{78} - Gd^{156}$	−87.5	2	53H58
$\frac{Se^{79} - Se^{78}}{Se^{80} - Se^{78}}$	0.50081	10	53H50
$HSe^{80} - C_6H_9$	−146.17	4	54C20
$2Se^{80} - Gd^{160}$	−94.3	2	54H4
$2Se^{80} - Dy^{160}$	−91.0	8	54H4
$H_2Se^{82} - C_6H_{12}$	−161.66	4	54C20
$2Se^{82} - Dy^{164}$	−95.2	8	54H4
$2Se^{82} - Er^{164}$	−96.5	4	54H4
$Br^{79} - C_6H_7$	−130.42	5	54C20
$2Br^{79} - Gd^{158}$	−86.6	2	54H4
Br^{79}/Br^{81}	0.975307	5	53H51
$Br^{81} - C_6H_9$	−154.05	5	54C20
$2Br^{81} - Dy^{162}$	−92.9	5	54H4
$Kr^{78} - 2C_3H_3$	−126.80	8	54C20
$Kr^{82} - 2C_3H_5$	−164.84	6	54C20
$Kr^{83} - C_6H_{11}$	−172.07	5	54C20
$Kr^{84} - 2C_3H_6$	−182.44	5	54C20
$Kr^{86} - 2C_3H_7$	−198.81	6	54C20
$Rb^{85} - C_6H_{13}$	−189.75	6	54C20
$2Rb^{85} - Er^{170}$	−111.7	8	54H4
$Rb^{87} - C_5H_{11}O$	−171.73	17	54C20
$Sr^{84} - C_6H_{12}$	−180.70	15	54C20
$Sr^{86} - C_6H_{14}$	−200.25	10	54C20
$Sr^{87} - C_5H_{11}O$	−172.05	6	54C20
$Sr^{88} - C_4H_8O_2$	−146.46	11	54C20
$2Sr^{88} - Hf^{176}$	−128.7	6	54H4
$2Y^{89} - Hf^{178}$	−131.6	6	54H4
$2Zr^{90} - Hf^{180}$	−137.1	3	54H4
$2Zr^{91} - W^{182}$	−135.5	3	54H4
$2Mo^{95} - Os^{190}$	−146.0	4	54H4
$3Ba^{138} - 2Pb^{207}$	−233.8	8	54H4
$Ce^{140} - 2Ge^{70}$	+56.8	6	53H58
$Pr^{141} - 3Ti^{47}$	+50.9	3	53H58
$Nd^{144} - 3Ti^{48}$	+66.7	3	53H58

MASS DIFFERENCES AND RATIOS continued

	Value		Ref.
$Nd^{144} - 2Ge^{72}$	+66.3	2	53H58
$Nd^{146} - 2Ge^{73}$	+65.8	4	54H4
$Nd^{148} - 2Ge^{74}$	+74.8	2	54H4
$Nd^{148} - 2Se^{74}$	+72.3	4	54H4
$Nd^{150} - 3Ti^{50}$	+85.2	5	53H58
$Nd^{150} - 2As^{75}$	+77.4	4	54H4
$Sm^{144} - 2Ge^{72}$	+66.9	8	54H4
$Sm^{148} - 2Ge^{74}$	+71.9	4	54H4
$Sm^{148} - 2Se^{74}$	+70.0	5	54H4
$Sm^{150} - 2As^{75}$	+72.5	8	54H4
$Sm^{152} - 2Ge^{76}$	+76.2	2	53H58
$Sm^{152} - 2Se^{76}$	+81.4	6	54H4
$Sm^{154} - 2Se^{77}$	+81.8	3	54H4
$Gd^{154} - 2Se^{77}$	+81.0	2	54H4
$Gd^{156} - 3Cr^{52}$	+100.4	4	53H58
$Gd^{156} - 2Se^{78}$	+87.5	2	53H58
$Gd^{158} - 2Br^{79}$	+86.6	2	54H4
$Gd^{160} - 2Se^{80}$	+94.3	2	54H4
$Dy^{160} - 2Se^{80}$	+91.0	8	54H4
$Dy^{162} - 2Br^{81}$	+92.9	5	54H4
$Dy^{164} - 2Se^{82}$	+95.2	8	54H4
$Ho^{165} - 3Mn^{55}$	+84.8	8	54H4
$Er^{164} - 2Se^{82}$	+96.5	4	54H4
$Er^{168} - 3Fe^{56}$	+126.0	3	54H4
$Er^{170} - 2Rb^{85}$	+111.7	8	54H4
$Hf^{176} - 2Sr^{88}$	+128.7	6	54H4
$Hf^{178} - 2Y^{89}$	+131.6	6	54H4
$Hf^{180} - 2Zr^{90}$	+137.1	3	54H4
$W^{182} - 2Zr^{91}$	+135.5	3	54H4
$Os^{190} - 2Mo^{95}$	+146.0	4	54H4
$Pb^{207} - 3Ga^{69}$	+196.6	8	53H58
$2Pb^{207} - 3Ba^{138}$	+233.8	8	54H4

53E15 A.Engler, H.Hintenberger, Helv. Phys. Acta 26, 657 (1953).

53H50 W.A.Hardy, G.Silvey, C.H.Townes, B.F.Burke, M.W.P.Standberg, G.W.Parker, V.W.Cohen, Phys. Rev. 92, 1532 (1953); 85, 494 (1952).

53H51 A.Honig, M.L.Stitch, M.Mandel, Phys. Rev. 92, 901 (1953).

53H58 B.J.Hogg, H.E.Duckworth, Can. J. Phys. 31, 942 (1953).

53W39 R.L.White, C.H.Townes, Phys. Rev. 92,1256 (1953).

54C20 T.L.Collins, W.H.Johnson, Jr., A.O.Nier, Phys. Rev. 94, 398 (1954).

54H4 B.J.Hogg, H.E.Duckworth, Can. J. Phys. 32, 65 (1954).

54M37 J.Mattauch, R.Bieri, Z. Naturforsch 9A, 303 (1954). In addition to the measured values listed above, the paper gives values adjusted for self-consistency.